30839

National Library of Canada
Bibliothèque nationale du Canada

**CANADIAN THESES ON MICROFICHE**

***THÈSES CANADIENNES SUR MICROFICHE***

NAME OF AUTHOR/*NOM DE L'AUTEUR* Ken W. Stickland

TITLE OF THESIS/*TITRE DE LA THÈSE* A Grain Handling and Transportation Policy System

UNIVERSITY/*UNIVERSITÉ* Un of Alberta

DEGREE FOR WHICH THESIS WAS PRESENTED/*GRADE POUR LEQUEL CETTE THÈSE FUT PRÉSENTÉE* Masters of Science

YEAR THIS DEGREE CONFERRED/*ANNÉE D'OBTENTION DE CE DEGRÉ* 1976

NAME OF SUPERVISOR/*NOM DU DIRECTEUR DE THÈSE* Dr. L. P. Apedaile

Permission is hereby granted to the NATIONAL LIBRARY OF CANADA to microfilm this thesis and to lend or sell copies of the film.

The author reserves other publication rights, and neither the thesis nor extensive extracts from it may be printed or otherwise reproduced without the author's written permission.

*L'autorisation est, par la présente, accordée à la BIBLIOTHÈQUE NATIONALE DU CANADA de microfilmer cette thèse et de prêter ou de vendre des exemplaires du film.*

*L'auteur se réserve les autres droits de publication; ni la thèse ni de longs extraits de celle-ci ne doivent être imprimés ou autrement reproduits sans l'autorisation écrite de l'auteur.*

DATED/*DATÉ* Aug 27, 1976 SIGNED/*SIGNÉ* Ken W Stickland

PERMANENT ADDRESS/*RÉSIDENCE FIXE*
10435 - 35A Ave.
Edmonton, Alberta
T6J 2H1

NL-91 (11-73)

INFORMATION TO USERS

THIS DISSERTATION HAS BEEN
MICROFILMED EXACTLY AS RECEIVED

This copy was produced from a microfiche copy of the original document. The quality of the copy is heavily dependent upon the quality of the original thesis submitted for microfilming. Every effort has been made to ensure the highest quality of reproduction possible.

PLEASE NOTE: Some pages may have indistinct print. Filmed as received.

Canadian Theses Division
Cataloguing Branch
National Library of Canada
Ottawa, Canada K1A 0N4

AVIS AUX USAGERS

LA THESE A ETE MICROFILMEE
TELLE QUE NOUS L'AVONS RECUE

Cette copie a été faite à partir d'une microfiche du document original. La qualité de la copie dépend grandement de la qualité de la thèse soumise pour le microfilmage. Nous avons tout fait pour assurer une qualité supérieure de reproduction.

NOTA BENE: La qualité d'impression de certaines pages peut laisser à désirer. Microfilmee telle que nous l'avons reçue.

Division des thèses canadiennes
Direction du catalogage
Bibliothèque nationale du Canada
Ottawa, Canada K1A 0N4

THE UNIVERSITY OF ALBERTA

# A GRAIN HANDLING AND TRANSPORTATION POLICY SYSTEM

by

© KEN W. STICKLAND

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF SCIENCE

DEPARTMENT OF RURAL ECONOMY

EDMONTON, ALBERTA

FALL, 1976

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "A Grain Handling and Transportation Policy System" submitted by Kenneth William Stickland in partial fulfilment of the requirements for the degree of Master of Science.

Supervisor

Michele Veeman

Date 20 July 1976

## ABSTRACT

Study has focussed on individual problems and alternate solutions for the grain handling and transportation system in Canada, taken one or two parts at a time. However the interconnectedness of the institutional, production, and marketing factors make this piecemeal approach impotent for creating understanding and a positive attitude to change. The objective of this study is to develop a systems policy analysis that clarifies the relationships among these factors.

Nine parts or subsystems are described: country elevators, inland terminals, railways, port terminals, Canadian Grain Commission, Canadian Wheat Board, farm storage, farm trucking, and provincial governments. Three targets for the System are throughput time, realized cost, and price charged to the farmer for services rendered. Movement toward these targets in inhibited to varying degrees by the need for subsystems to generate investment for capital replacement and development, and by the impact of the system on provincial and municipal government revenue and expenditures.

Thirty-nine statements or functional forms comprise the Model. Diagrams and functional forms are used to clarify linkages between endogenous variables and those exogenous variables judged controllable.

Twenty-two quantitative policy instruments are selected and evaluated for their historical role, their possible influence, their administrative simplicity and their side effects. Elevator and terminal handling tariffs, abandonment of branchlines, and payments for trucking to distant elevators or inland terminals are among the more

influential instruments assessed. Issues identified for possible institutional change include: changes to the level and structure of the statutory grain rate, encouragement of satellite or off-track elevators, compensation for cost transfers to farmers and local or procincial governments, and regulation of handling tariffs.

The comprehensive conceptual approach in this study could facilitate assessment of the ramifications of many alternate policy changes in grain handling and transportation.

# ACKNOWLEDGEMENTS

In the preparation of this thesis, I am indebted to many people for information and inspiration. I am particularly grateful to Dr. L.P. Apedaile for his personal interest in my work and career, for his patience and persistence throughout this long study, for his insight into policy analysis and for the critical pen and spirited debate which molded several drafts into a readible manuscript. Thank you Peter.

I had the good fortune to benefit during 1975 and 1976 from association with many people in the grain industry, railways, farm community, Alberta Transportion, Alberta Agriculture, and the Hall Commission on Grain Handling and Transportation. Their observations and critiques of many alternatives were particularly helpful in making the study more pragmatic and current. To Clarence Roth, my thanks for his encouragement that I finish my study.

I owe special thanks to those who provided helpful advice on the manuscript. Mr. W. Hendricks, Dr. A.W. Platt, Dr. E.W. Tyrchniewicz and Dr. M.M. Veeman made many suggestions on the text. A very special thanks goes to Mrs. D. Johnston for her endurance in typing the manuscript under deadline pressures. To Mr. R. Bence my thanks for help with diagrams, to Ms. E. Shapka my thanks for encouragement and editorial assistance.

My parents, brothers, and friends deserve much credit for the forces which played upon my life to guide me this far. Finally, Donna, without your dedication, loyalty, patience, and assistance, the completion of this project would have been impossible.

# TABLE OF CONTENTS

Page

ABSTRACT . . . . . . . . . . . . . . . . . . . . . . . . . iv

ACKNOWLEDGEMENTS . . . . . . . . . . . . . . . . . . . . . vi

LIST OF TABLES . . . . . . . . . . . . . . . . . . . . . . x

LIST OF FIGURES . . . . . . . . . . . . . . . . . . . . . xii

***

CHAPTER

I. INTRODUCTION . . . . . . . . . . . . . . . . . . . 1

The Context . . . . . . . . . . . . . . . . . . 1

General Statement of the Problem . . . . . . . . 2

Objectives and Organization of the Study . . . . 5

II. REVIEW OF THEORY . . . . . . . . . . . . . . . . . 7

Models . . . . . . . . . . . . . . . . . . . . . 7

Systems Analysis . . . . . . . . . . . . . . . . 8

The Theory of Quantitative Economic Policy . . . 11

Muddling Through . . . . . . . . . . . . . . . . 17

Investment Theory . . . . . . . . . . . . . . . 19

III. SUMMARY OF POLICY MODEL . . . . . . . . . . . . . 24

Introduction . . . . . . . . . . . . . . . . . . 24

Definition of Subsystems. . . . . . . . . . . . . 24

Symbol Convention for the Model . . . . . . . . . 26

Specification of Target and Side Effect Variables in the Model . . . . . . . . . . . . . 29

The Model . . . . . . . . . . . . . . . . . . . 40

Summary . . . . . . . . . . . . . . . . . . . . 55

CHAPTER PAGE

IV. COUNTRY ELEVATOR SUBSYSTEM . . . . . . . . . . . . . 57

Introduction . . . . . . . . . . . . . . . . . . 57

Structural Relationships Involving Non-Target Variables . . . . . . . . . . . . . . 59

Structural Relationships Involving Target Variables . . . . . . . . . . . . . . . . 68

Policy Implications. . . . . . . . . . . . . . . . 73

Summary . . . . . . . . . . . . . . . . . . . . . 82

V. INLAND TERMINALS . . . . . . . . . . . . . . . . . 84

Introduction . . . . . . . . . . . . . . . . . . 84

Structural Relationships . . . . . . . . . . . . 86

Policy Implications . . . . . . . . . . . . . . . 96

Summary . . . . . . . . . . . . . . . . . . . . . 106

VI. RAILWAY SUBSYSTEM . . . . . . . . . . . . . . . . 107

Introduction . . . . . . . . . . . . . . . . . . 107

Structural Relations . . . . . . . . . . . . . . 110

Policy Implications: Quantitative . . . . . . . 120

Policy Implications: Institutional. . . . . . . 128

Summary. . . . . . . . . . . . . . . . . . . . . 135

VII PORT TERMINAL SUBSYSTEM . . . . . . . . . . . . 136

Introduction . . . . . . . . . . . . . . . . . . 136

Structural Relationships . . . . . . . . . . . . 137

Policy Implications. . . . . . . . . . . . . . . 145

Summary. . . . . . . . . . . . . . . . . . . . . 152

CHAPTER PAGE

VIII. CANADIAN GRAIN COMMISSION AND CANADIAN WHEAT BOARD SUBSYSTEMS . . . . . . . . . . . . . . . . 154

Introduction . . . . . . . . . . . . . . . . . . 154

The Canadian Grain Commission . . . . . . . . . 154

The Canadian Wheat Board . . . . . . . . . . . . 162

Summary . . . . . . . . . . . . . . . . . . . . 174

IX FARM STORAGE AND TRUCKING SUBSYSTEM . . . . . . . 175

Introduction . . . . . . . . . . . . . . . . . . 175

Farm Storage . . . . . . . . . . . . . . . . . . 175

Trucking Subsystem . . . . . . . . . . . . . . . 184

X PROVINCIAL AND MUNICIPAL GOVERNMENTS . . . . . . . 201

Introduction . . . . . . . . . . . . . . . . . . 201

Structural Relationships . . . . . . . . . . . . 201

Policy Implications. . . . . . . . . . . . . . . 207

Summary. . . . . . . . . . . . . . . . . . . . . 214

XI SUMMARY AND IMPLICATIONS FOR FURTHER STUDY . . . . 215

Summary . . . . . . . . . . . . . . . . . . . . 215

Areas Identified for Institutional Change. . . . 222

Reservations and Implications for Further Study. 223

***

BIBLIOGRAPHY . . . . . . . . . . . . . . . . . . . . . 226

APPENDIX A . . . . . . . . . . . . . . . . . . . . . . 235

APPENDIX B . . . . . . . . . . . . . . . . . . . . . . 237

# LIST OF TABLES

| Table | Description | Page |
|---|---|---|
| 3.1 | Marketing function, asset ownership, and control of export movement by subsystem | 25 |
| 3.2 | Estimated realized costs, per bushel, for 1969/70, 1971/72, 1973/74 | 31 |
| 3.3 | Estimated price paid by farmers for transporting, handling and marketing wheat from Scott, Saskatchewan to ships at Thunder Bay or Vancouver, 1969-70, 1971-72, 1973-74 | 34 |
| 4.1 | Elevator units and average storage capacity, 1970/71 to 1974/75 | 67 |
| 4.2 | Side effects of instruments considered for country elevator subsystem (#1) | 80 |
| 5.1 | Number, location, and capacity of inland terminals in 1976, by owner | 85 |
| 5.2 | Side effects of instruments selected for inland terminal subsystem (#2) | 98 |
| 6.1 | Total railway costs and revenues for moving grain in 1974 | 115 |
| 6.2 | Side effects of instruments selected for railway subsystem (#3) | 122 |
| 6.3 | Side effects of institutional policy changes for the railway subsystem (#3) | 132 |
| 7.1 | Side effects of instruments selected for port terminal subsystem (#4) | 148 |
| 8.1 | Realized costs of operating the Canadian Grain Commission, 1971 to 1974 | 157 |
| 8.2 | Receipts, realized cost, and price to farmers in operation of the Pool Account for wheat, 1971/72 to 1974/75 | 169 |
| 8.3 | Side effects of new instruments selected for Canadian Wheat Board (Subsystem #6) | 172 |

| Table | | Page |
|---|---|---|
| 9.1 | Expected increases in investment in repair and new construction associated with a hypothetical increase of $1,000 in farm net income, by province | 177 |
| 9.2 | Side effects of instruments selected for farm storage subsystem (#7) | 181 |
| 9.3 | Average cost of hauling grain to elevators by farm truck in cents per bushel, 1974 | 187 |
| 9.4 | Expected increases in new and repair investment in machinery and equipment associated with a hypothetical increase of $1,000 in farm net income, by province | 194 |
| 10.1 | Net present value of realized costs to communities and the Government of Alberta resulting from possible rail line abandonment | 204 |
| 10.2 | Number of elevator units, subdivision length, and bushel miles of additional truck haul, by subdivision | 205 |

## LIST OF FIGURES

| Figure | | Page |
|---|---|---|
| 2.1 | A theory of economic policy | 14 |
| 3.1 | Example linkages between guidance and handling subsystem variables | 27 |
| 3.2 | Time chart for handling and transportation (TMST) and for storage (TS) for a hypothetical bushel moving through the system via country elevators, by subsystem | 37 |
| 3.3 | Example of policy relationships of variables in this model of the grain handling and transportation system | 41 |
| 3.4 | Linkages or causal ordering of endogenous variables | 44 |
| 3.5 | Exogenous and Endogenous variables in the model | 56 |
| 4.1 | Logical relationships among variables endogenous to country elevator subsystem (#2) | 58 |
| 4.2 | Logical relationships affecting incidental variables in country elevator subsystem (#1) | 59 |
| 4.3 | Producer deliveries by month (all grains) crop year 1973-74 | 62 |
| 4.4 | Logical relationships affecting target variables in country elevator subsystem (#1) | 68 |
| 4.5 | Instrument - target linkages selected for elevator subsystem (#1) | 74 |
| 5.1 | Logical relationships among variables in the inland terminal subsystem (#2) | 87 |
| 5.2 | Instrument-target linkages selected for inland terminal subsystem (#2) | 97 |
| 6.1 | Logical relationships among variables endogenous and exogenous to railway subsystem (#3) | 109 |
| 6.2 | C.P. Rail Grain Car Cucle to Vancouver, 1973 | 112 |
| 6.3 | Instrument - target linkages selected for railway subsystem (#3) | 121 |

| Figure | | Page |
|---|---|---|
| 7.1 | Logical relationships among variables endogenous and exogenous to (port terminal) subsystem (#4) | 138 |
| 7.2 | Instrument-target relationships affecting port terminal subsystem | 146 |
| 8.1 | Logical relationships among variables endogenous and exogenous to Canadian Grain Commission (subsystem #5) | 156 |
| 8.2 | Instrument-target linkages for instruments controlled by the Canadian Grain Commission | 159 |
| 8.3 | Logical relationships among variables endogenous and exogenous to Canadian Wheat Board subsystem (#6) | 165 |
| 8.4 | Instrument-target linkages affecting variables endogenous to Canadian Wheat Board (subsystem #6) | 170 |
| 9.1 | Logical relationship among variables endogenous and exogenous to farm storage subsystem (#7) | 176 |
| 9.2 | Instrument-target linkages affecting farm storage subsystem (#7) | 182 |
| 9.3 | Logical relationships among variables endogenous and exogenous to trucking subsystem (#7) | 185 |
| 9.4 | Instrument-target linkages affecting trucking subsystem (#8) | 196 |
| 10.1 | Net present value of realized costs to communities and the Government of Alberta resulting from possible rail line abandonment | 204 |
| 10.2 | Instrument - target linkages in provincial and municipal governments subsystem (#10) | 208 |

# CHAPTER I

# INTRODUCTION

## The Context

Since the 1969 establishment of the Grains Group under the Honorable Otto Lang, the history, function, limitations, and future of the Prairie grain handling and transportation system has been analysed and debated by every group with a stake in Prairie agriculture. In the spring of 1976, when this study was being completed, the Grain Handling and Transportation Commission (hereafter called the Hall Commission) had just finished an audit of producer and small center viewpoints in over 70 local hearings in Prairie centers. Yet, despite the many studies made by the Canada Grains Council and others and the seven years of debate since 1969, the author perceived at Hall Commission hearings in Alberta that some farmers continued to have difficulty clarifying the issues and trade-offs. This study commenced in 1971 to identify the trade-offs and issues. The issues are far clearer today and have been well described by the Canada Grains Council and Kulshreshtha. Yet the interactions and policy alternatives between functions like farm storage and port storage or sectors like inland terminals and country elevators remain obscure under masses of studies or emotion. Agricultural leaders and the Hall Commission must develop a clear picture of the alternatives so that difficult but necessary decisions are made soon.
The author delineates in this study the interdependencies of the system at the operational, pricing, and policy level in a way which should contribute to simplifying and clarifying policy choices available to deal

with the problems. Firstly, what are the system problems identified to date?

## General Statement of the Problem

In its recent Definition of the Problem, the Canada Grains Council characterizes the grain handling and transportation system as having:

1. A severe cost/revenue squeeze.
2. An evident decline in the physical state of the system.
3. A restricted capability to generate or attract the necessary capital to renew existing facilities or develop an adequate alternative system.
4. Increasing direction from the federal government and concern on the part of provincial governments.[1]

The Council suggests the above financial and government concerns arise because "individual grain companies and railways are unable to resolve these financial difficulties by the means available to them within the various restraints, imposed or otherwise."[2] One such restraint cited is the policy of developing a least cost handling and transportation system by "keeping the cost to the producer low through a rate schedule rater than through an efficient and economic handling system".[3] The Council suggests that the statutory rate structure on the movement of grain by rail has been maintained as the fulcrum around which improvements to date have been implemented. Yet changes to "the number of elevators...the rail line abandonment freeze...rail rates... government provision of railway grain rolling stock...and subsidization of uneconomic rail lines...are all involved in the potential solution."[1]

---

[1] Canada Grains Council, Definition of the Problem (Winnipeg: Canada Grains Council, 1975), p. 2 (Hereinafter referred to as (1975b).).

[2] Ibid., p. 2.

[3] Ibid., p. 2.

The Council also cites unpredictability of labor stoppages as an important factor interfering with or preventing the planned movement of grain. Honey[2] confirms this with an estimate of $2 billion lost in export sales due to strikes during two crop years from 1973 to 1975. He further estimates that this loss escalates to an $8 billion loss to the Canadian economy once the multipliers are considered.

Other problems of adjustment identified by the Grains Council include:[3]

1. Restructuring of the system may necessitate weakening the protection to the producer offered through the quota system, the Bracken formula, the producer car, and control of elevator handling rates.

2. Depressed rates do not permit stakeholders to compensate others for providing additional services and facilities needed to minimize overall cost.

3. Additional costs of trucking grain from the farm to elevator delivery stations will result, if an when low volume stations cease to remain in operation and/or rail service is terminated.

---

[1] Ibid., p. 3.

[2] G.K. Honey, A Memorandum to the Canadian Taxpayer: The High Cost of Strikes in the Food Distribution System (Calgary: Alberta Wheat Pool, 1975), p. 31.

[3] Canada Grains Council (1975b), op. cit., p.3.

4. Provincial governments are concerned that elevator closure may mean: (a) possible additional expenses of increased road maintenance and capital costs, (b) possible tax loss to municipal governments, (c) possible closure of other businesses, and (d) loss of jobs.

Kulshreshtha notes that problems or conflicts exist between federal and provincial governments, railways and grain producers, elevator companies and grain producers, railways and elevators companies, livestock producers and grain producers, small and mid-size communities, and municipal governments and railways.[1] He indicates the role of a compensation policy to deal with these conflicts is as yet unresolved.

Additional issues as yet unresolved include:[2]

1. Development of a clear-cut objective for the system.
Should it be: Maximum flexibility to all parties?
Minimum disruptive effect on institutions such as rural communities?
Minimum cost to the producer? To the system?
Minimum social cost?

2. The desirable level of capacity to move expected export volumes and peak period volumes.

3. The level and location of grain inventories (on the farm or in country elevators?)

---

[1] Surendra N. Kulshreshtha, A Current Perspective on the Prairie Grain Handling and Transportation System, No. 269 (Saskatoon: University of Saskatchewan Extension Division, 1975), p. 30. (Hereinafter referred to as (1975a).).

[2] Kulshreshtha, (1975a), op. cit., pp. 48-51.

4. The effect of changes to the System on energy requirements.

5. The indirect effects on farmers of increased hauling distances with regard to queueing at elevators during peak periods, quality of various farm services, enterprise mix, geographic monopolies by elevator or trucking firms.

This section has identified the general problems facing the grain handling and transportation system. Additional details on dilemmas in each sector will be provided later in this study as will a systematic method of interrelating the above issues.

## Objectives and Organization of the Study

The prime objective of this thesis is to identify and assess the policy means of dealing with many of the above problems of the grain handling and transportation system. To do this, the study outlines and then utilizes the principles of systems analysis and goal-oriented, quantitative economic policy. Sub-objectives of the study include:

1. To simplify into a conceptual model some of the many operational, pricing, and policy considerations that affect performance of the grain handling and transportation system over time. Interactions or linkages between parts of the system are stressed.

2. To identify quantitative policy instruments and, with the aid of the model, to assess the policy implications of changing these instruments. Where adjustments in the level of instruments are judged insufficient to improve performance, institutional changes are suggested and evaluated.

3. To present an approach which policy makers can use for developing and assessing policies for a subsystem in a manner that takes

into account the goals and side effects on other subsystems.

This thesis is divided into eleven parts. Chapter II reviews supporting theory for the utilization of quantitative economic models as a tool of policy analysis. Investment models are developed. Chapter III identifies the goals for the system, divides the system into subsystems, and summarizes the policy model detailed later in the study. Chapters IV through VII build the model as well as select and assess policy instruments for each of the following: country elevators, inland terminals, railways, and port terminals. Chapter VIII adds to the analysis the institutional costs and policy impact of the Canadian Grain Commission and Canadian Wheat Board. In Chapter IX, farm controlled subsystems are modelled and policies affecting them are assessed. The external effects of system changes on provincial and municipal governments are identified in Chapter X with the associated policy options and implications. Chapter XI includes a brief summary and recommendations for additional research.

## CHAPTER II

## REVIEW OF THEORY

Chapter II gives background on why models are used and how they assist policy choices. A brief overview of systems analysis is included. "Muddling through" or disjointed incrementalism is compared to the systems approach and is rejected. Lastly, investment theory is briefly reviewed in order to form a basis for modelling investment behaviour in this study.

### Models

The use of models to study agriculture and assess alternative policies has been widespread in the world for over twenty years. At a 1972 Canadian symposium on National and Regional Economic Models of Agriculture, Gilchrist summed up the reasons why models are needed:

> They (models) are needed to understand the system in terms of identification of variables, their behaviour and inter-relationships. They are needed to sort out the significant variables in the system and enable greater efficiency in studying and managing the system or its components. Models can be extremely useful for projecting the behaviour of a system and thereby assisting in problem identification and the evaluation of alternative solutions, which often are in the form of policies and programs. There is also the need for continuous monitoring of the system to identify the changes necessary or likely to occur in the system, the constraints to adjustment or development and new "investment" opportunities.[1]

---

[1] Varge Gilchrist, "Background and Purpose of the Symposium" in National and Regional Economic Models of Agriculture, ed. by Rober K. Eyvindson, #72/9 (Ottawa: Economics Branch, Agriculture Canada, 1972), p. 2.

Gilchrist identified the following four general types of economic models available to describe and analyze systems:

1. Econometric Models
2. Simulation Models
3. Mathematical Programming Model
4. Input-Output Models.[1]

This study combines types one and two with a policy approach and thereby recognizes the many interdependencies of the grain handling and transportation system.

### Systems Analysis

A system can be characterized as "a unity defined of many diverse parts subject to a common plan or serving a common purpose; or, alternatively, components that work together for the overall objective of the whole."[2] Thus any system has one or more objectives or purposes often measured in terms of the outputs of the system or the distribution of system outputs. In addition to purposes and outputs, all physical systems have five additional characteristics: inputs, a transformation function or process, equipment, an environment, and human agents who act as activators of the system or receiver of system or receivers of system output.[3]

---

[1] Ibid., p. 2.

[2] Economic Council of Canada, Design for Decision-Making (Ottawa: Queen's Printer, 1971), p. 28.

[3] Gerald Nadler, Work Systems Design: The Ideals Concept (Homewood, Illinois: Richard Irwin Inc., 1967), p. 7.

Systems analysis stresses interrelatedness among the essential elements of a system and between a system and its environment -- the whole system and all the factors that bear on it must be considered together. Systems do not stand alone or move in isolation -- they exist in hierarchies that touch, overlap or are mutually interdependent.[1] The nature of the interfaces or boundaries between social systems may be a function of technical variables, behavioural variables (economic, social, or political), or institutional factors.

In examining administrative capability to encourage change in a system's framework, Katz[2] suggests three dimensions of organizational systems. First, all systems have substantive and instrumental (survival) purposes. As a second dimension, every organizational system must carry on four functions to establish and achieve its purposes. These functions can be organized into organizational entities or subsystems:

> 1. The transformation subsystem, a production, conversion and technical subsystem transforms inputs into organizational outputs or payoffs...
> 2. The maintenance subsystem...maintains the patterned behaviour necessary to carry on the transformation activities...
> 3. The adaption subsystem is concerned with the survival of the organization...in a changing environment.
> 4. A guidance subsystem directs and coordinates all the activities of the organization.[3]

To Katz, the third dimension in an organizational system is environmental linkages -- authoritative (enabling) linkages, resource (support) linkages, normative linkages, and diffuse (undefinable) linkages.[1]

---

[1] Economic Council of Canada, op. cit., pp. 28-29

[2] Saul M. Katz, "Administrative Capability and Agricultural Development: An Institution-Building Approach to Evaluation," Journal of Agricultural Economics, Vol. 52, No. 5 (1970), p. 797.

[3] Ibid., pp. 797-798.

Systems with similar functions or purposes can exist together as parallel systems or as a hierarchy of systems. Systems within a larger system are called subsystems. Subsystems may vary in their individual autonomies from other subsystems and in their importance or impact within the total system. Thus minor decisions in one subsystem may be very interdependent or competitive with other subsystem decisions while a major decision in another subsystem may have little interrelatedness with other subsystems.

The Planning, Programming, Budgeting System as developed in the United States is a practical, administrative example of systems analysis used in governments. This approach emphasizes the formulation of total programs and their costs over time, not just for one year but for at least several years ahead.[2] Systematic program development requires compatible budgetary and decision-making timetables.[3] The specification of valued output variables or objectives focuses all the information retrieval needs of a policy. This focussing reduces the load of feedback information to be collected for evaluation of (a) the objectives, (b) the analysis, and (c) the program designs used in an ongoing policy.[4]

---

[1] Ibid., p. 798.

[2] Charles L. Schultz, The Politics and Economics of Public Spending (Washington: The Brookings Institute, 1968), pp. 21-22.

[3] Schultz, op. cit., p. 23. See also R.E. Prokosch, "Planning Programming, Budgeting - A Case Study: The Federal Department of Manpower and Immigration"(unpublished research paper, Carleton University, Ottawa, 1970), pp. 29-31.

[4] Pierre Clavel and P. Everts, "The Organization of Data for Public Policy"(Paper presented at Rural Sociology Society Annual Meeting, Denver, Colorado, 1971), pp. 1-3.

## The Theory of Quantitative Economic Policy

The theory of quantitative economic policy utilizes systems analysis to focus on decision situations and policy problems of an economic nature. Fox, Sengupta, and Thorbecke[1] provide an overview of the theory and, more specifically, the use of models. They suggest quantitative analysis be divided into three interrelated stages:

1. Characterization of the policy problem: specification of the preference function, the quantitative model and the constraints or boundary conditions.
2. The selection problem: classification of variables by their properties such as randomness, direct or indirect controllability, and time-dependence.
3. The steering problem: derivation of optimum decision rules in a static or dynamic sense and the flexibility of optimal decision-making procedures under changing conditions associated with risk, uncertainty and the sequence of new information.[2]

In carrying out the above steps, Fox[3] suggests that objectives for systems and subsystems first be translated into specific quantifiable goals or targets. Ideally, the trade-off preferences between goals are known and translated into a flexible objective function for the system. That is, any system will seek to maximize welfare (W) through an objective function as follows:

$$\text{Maximize } W = a_1y_1 + a_2y_2 + \ldots + a_iy_i$$

where: $a_1, a_2, \ldots a_i$ = trade-offs between a unit of any goal and one unit of a base goal (like $y_1$),

$i$ = the number of goals

---

[1] K.A. Fox, J.K. Sengupta and E. Thorbecke, The Theory of Quantitative Economic Policy (Chicago: Rand McNally and Co., 1966), Chapters 1 and 2.

[2] Ibid., p. 11.

[3] Ibid., pp. 14-15.

Maximization of welfare is subject to any upper or lower limits on goals and the structure of the model of the system being maximized.

If trade-offs between instruments are known with respect to efficiency and policymaker preferences, these instruments ($z_j$) also enter the preference function. For example:

$$\text{Maximize } W = (a_1y_1 + a_2y_2 + \ldots q_iy_i) + (b_1z_1 + b_2z_2 + \ldots + b_jz_j) \qquad 2.2$$

where: $b_1$, $b_2$, and $b_j$ = trade-offs between instruments $z_j$,
$j$ = number of instruments.

Several problems present themselves when building an objective function like 2.2. To obtain trade-offs for just the goal variables (symbolized by $a_i$), the stakeholders for a system must first be identified and then their trade-offs estimated from public statements or private interviews. This method was not practical for this study. While attitude surveys are available for the farm viewpoint of the grain handling and transportation system,[1] such surveys do not show trade-offs between goals. No trade-offs have been identified for the other key decisionmakers in the System. Lastly, if each of the nine subsystems had three goals, there are 1,404 combinations[2] of goals,

---

[1] Bruno A. Friesen, Summary of Response to an Attitude Questionnaire Conducted with Grain Producers (Calgary: Alberta Wheat Pool, 1971). (Mimeographed.)

[2] Combinations are calculated from $nCr = \frac{n!r!}{(n-r)!}$ where n= total population, r = size of each combination. Thus, where n = 9 x 3 = 27 and r = 2,

$$_{27}C_2 = \frac{27! \times 2!}{25!} = 1{,}404$$

an interview task too impractical for a study such as this. A simpler, more pragmatic method was identified by Tinbergen. Fox, et. al., summarizes Tinbergen's approach as follows:

> Tinbergen...in his discussion of the theory of economic policy, distinguishes between "target variables" (effect variables in a broad sense) and "instrument variables" (cause variables in a broad sense). (Tinbergen suggests) ...the theory of economic policy (at least in a fixed-target model) takes the desired values of the target variables to be given and calculates the constellation of values of the instrument variables required to attain the given targets.[1]

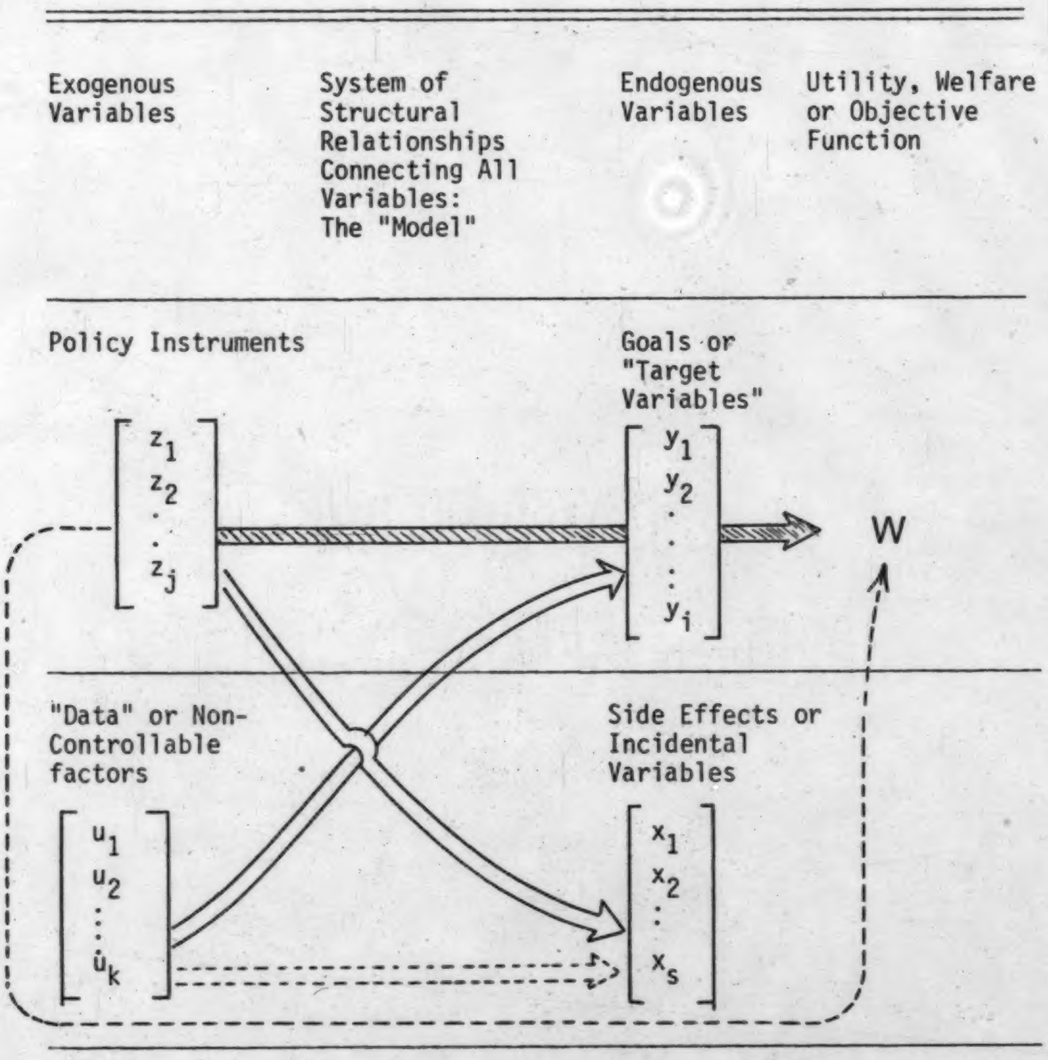
That is, verbal objectives are still mathematically expressed as specific goal variables ($y_i$) yet trade-offs are arbitrarily expressed by fixing the level of each goal or target variable[2] at a target level (call them a vector y*). Tinbergen's model is then completed by constructing a model which sets up the statistical or empirical relationships between targets and other variables including instruments. These other variables in the structure of the model are divided according to their mathematical and systems role; there are those within the system (endogenous) and those outside the system (exogenous). Exogenous factors which are directly or indirectly controllable (i.e., they can be manipulated) are instruments (Z). Uncontrollable, or predetermined, exogenous variables are called data variables (U). Endogenous variables other than the targets (Y) become side effects or incidental variables (X). Total welfare (w) is a function of targets and instruments. This classification of variables is clarified by Figure 2.1.

---

[1] Fox, et al., p. 13.

[2] Alternatively, goal variables can be forecasted over time as if uninfluenced by any new policies. The difference between these forecasts and fixed targets becomes a policy gap (y**) which becomes the target.

Figure 2.1: A theory of economic policy


Exogenous Variables
System of Structural Relationships Connecting All Variables: The "Model"
Endogenous Variables
Utility, Welfare or Objective Function
Policy Instruments
Goals or "Target Variables"
$z_1$
$z_2$
$z_j$
$y_1$
$y_2$
$y_i$
W
"Data" or Non-Controllable factors
Side Effects or Incidental Variables
$u_1$
$u_2$
$u_k$
$x_1$
$x_2$
$x_s$

Source: K.A. Fox, J.K. Sengupta, and E. Thorbecke, The Theory of Quantitative Economic Policy (Chicago: Rand McNally & Co., 1966), p. 21.

Tinbergen distinguishes three types of policies.[1] Quantitative policies deal with levels or quantities of instrument variables (like the interest rate). Qualitative or structural policies involve a change in the structural relations and hence, in coefficients and the form of mathematical equations (example: change in the freight rate structure). Reform policies involve widespread changes in societal value systems (an example is a change to government ownership of property). This study will only select quantitative policy instruments and recommend several structural policies where quantitative policies are judged as insufficient.

Mathematically, the policy problem becomes one of characterizing and selecting variables to form equations or structural relationships. Linear equations will take the form:

$$AY = BZ + CU + DX \qquad 2.3$$

where A, B, C, and D are matrices of structural coefficients whose elements can often be calculated by ordinary least squares or two-stage least squares. The incidental variables (X) can be removed by algebraic means[2] leaving, in rearranged form,

$$BZ = AY - CU. \qquad 2.4$$

If the matrix B is identifiable (that is, B has constant elements, is square and nonsingular), its inverse ($B^{-1}$) can be calculated.

---

[1] Jan Tinbergen, On the Theory of Economic Policy (Amsterdam: North Holland Publishing Co., 1966), Chapter 1.

[2] In some models, incidential or "side-effect" variables should be retained since they may approach the same importance (as constraints) as targets.

Hence, a unique vector of Z instruments can be obtained (given target levels Y* and exogenous data (U)) by multiplying the equation (2.4) by the inverse $(B^{-1})$:

$$Z = (B^{-1}A)Y^{*} - (B^{-1}C)\,U \qquad 2.5$$

Three features of a policy model follow from the above variable classification and mathematical approach. First,[1] policy models must be more than ordinary econometric forecasting models. They must contain additional features which permit steering or manipulation of instruments; instruments cannot be passive (merely projected from past trends).

Secondly, consistency in the policy sense[2] requires that the number of instrument variables should be greater than or equal to the number of targets. In a fixed target model, the number of instruments should equal the number of targets. The necessary condition to solve for all unknowns of a policy problem is that the number of structural equations equals the number of instruments plus incidental variables.[3]

Thirdly, policy theory studies the problem of decomposition of an over-all model into a set of submodels. Recursiveness, the ability of one submodel to provide solutions and predictions given previous solutions in other submodels, is crucial in economic policy. It can be shown[1] that various degrees of decentralization without much subordination is possible among subsystems or submodels if matrices A and B are diagonal, triangular, quasi-diagonal, block-diagonal, quasi-triangular or block-triangular. Where B and A are strictly triangular and of similar dimensions, the policy model given by (2.5) is called recursive.[2] The first element of Z ($Z_1$) is dependent only on the first element of Y ($Y_1$). The second element of Z ($Z_2$) is dependent only on $Z_1$, $Y_1$ (which have already been solved) and $Y_2$. Consequently, "if each equation were assigned to a different policy-maker, the system of equations would specify a hierarchy such that a policy-maker in a given position need not look at the instruments selected by those who are below his position in hierarchy of equations in order to determine his own optimal policy."[3] Where possible, the model in this study has been specifically oriented to allow for easy recursive solution and, hence, decentralized independent or recursive decisions.

---

[1] Fox, _et al._, _op_. _cit_., p. 15.

[2] _Ibid_., p. 22.

[3] See _Ibid_. for a comparison of policy consistency with equational and statistical consistency.

## Muddling Through

The explicit separation of goals (or ends) from instruments (or means) in quantitative economic policy analysis is only one approach to policy-making. Hirschman and Lindbloom have identified the use of "muddling through" or "disjointed incrementalism" as the contrasting behaviour most frequently used by policy-makers. The assumptions and approaches of disjointed incrementalism are described by Hirschman and Lindbloom in the following way:

---

[1] Ibid., p. 15.

[2] Such models then form a causal ordering or "vector" causality of the Simon variety. (See Ibid., pp. 24, 25 and 65-66.)

[3] Ibid., p. 25.

> 1. Attempts at understanding are limited to policies that differ only incrementally from existing policy.
> 2. Instead of simply adjusting means to ends, ends are chosen that are appropriate to available or nearly available means.
> 3. A relatively small number of means (alternative possible policies) is considered, as follows from 1.
> 4. Instead of comparing alternative means or policies in the light of postulated ends or objectives, alternative ends or objectives are also compared in the light of postulated means or policies and their consequences.
> 5. Ends and means are chosen simultaneously; the choice of means does not follow the choice of ends.
> 6. Ends are indefinitely explored, reconsidered, discovered, rather than relatively fixed.
> 7. At any given analytical point ("point" refers to any one individual, group, agency, or institution), analysis and policy making are serial or successive; that is, problems are not "solved" but are repeatedly attacked.
> 8. Analysis and policy-making are remedial -- they move away from ills rather than toward known objectives.
> 9. At any one analytical point, the analysis of consequences is quite incomplete.
> 10. Analysis and policy making are socially fragmented; they go on at a very large number of separate points simultaneously.[1]

Muddling through is easier and can be carried out with more limited resources than is required for systems analysis and economic policy models. The theory acknowledges and encourages participation in policy-making by those with limited research facilities, such as the general citizenry. This theory of incrementalism closely reflects the simultaneous influencing of ends and means that go on every day in the political world. This process was clearly used by the grain handling and transportation system prior to the Grains Group activity of 1969.

---

[1] A.O. Hirschman and C.E. Lindbloom, "Economic Development, Research and Development, Policy-Making: Some Converging Views," in Systems Thinking (Selected Readings), ed. by F.G. Enery (Suffolk, United Kingdom: Penguin, 1969), p. 357-358.

However, in the author's view, the problems of the System outlined in Chapter I require more complete and simultaneous assessments of policy alternatives and their consequences. Smaller incremental steps like increases in handling tariffs have reached the limit of their effectiveness as separate or incremental policy innovations. Kahn suggests several situations where he feels that coordinated "social planning" is warranted. Social planning or systematic economic policy should be used when:

> Translating new social goals into effective programs;
> Introducing social (non-market) considerations into market situations;
> Redesigning services to meet intended target populations;
> Responding to inconsistencies and diffuseness in service strategies;
> Allocating scarce resources.[1]

All these conditions presently exist in the complex and interdependent grain handling System. The appointment of the Hall Commission to look simultaneously at all facets of the grain handling and transportation system is an indication that the Federal cabinet also feels the time is ripe for a systematic analysis of the whole system.

## Investment Theory

This section will make a short survey of investment theory in anticipation of adapting general investment decision models later to each subsystem of the policy model. Problems with lags, quarterly data, and aggregation which still limit investment theory also face the grain handling system.

---

[1] Alfred J. Kahn, Theory and Practise of Social Planning (New York: Russell Sage Foundation, 1969), Chapter 1.

In a comparison of business investment models for the United States, Bischoff asserts:

> ...to date no concensus has developed among economists about the determinants of investment...or about the magnitude and timing of the effects of monetary and fiscal policies on this aggregate.[1]

A review of the literature would concur. It should be noted that investment is usually defined as gross investment in plants (building construction) and equipment. For use in a policy model, any investment behaviour equation should give induced (not autonomous) investment; models of investment should be susceptible to fiscal or monetary instruments. Models reviewed below are further restricted to linear equations with variables susceptible to estimation in a Canadian marketing sector.

Models like those outlined by Bischoff,[2] and Jorgenson and Siebert[3] are quarterly and rely for their accuracy upon sophisticated distributed lags[4] in certain explanatory variables. To simplify presentation in this study, only annual models are used and only two periods (years) are shown, the current and the previous year.

---

[1] Charles W. Bischoff, "Business Investment in the 1970's: A Comparison of Models, "Brookings Papers on Economic Activity, 1(1971), p. 13.

[2] Ibid., pp. 13-24.

[3] Dale W. Jorgenson and Calvin D. Siebert, "A Comparison of Alternative Theories of Corporate Investment Behaviour", American Economic Review, Vol. 58, No. 4 (1968), pp. 681-712.

[4] Jorgenson and Siebert very clearly show that correct lag weighings are crucial for accurate equations. The experiment so as to individually fit different Pascal distributions into the right equation. Bischoff calculates Almon lag weights as far back as 23 quarters.

Jorgenson and Siebert assert that all models begin with the flexible accelerator principle[1] and, subsequently, substitute alternative specifications for deriving the desired level of capital. Initially the acceleration principal says "a firm forms expectations about its future output on the basis of the past output (or sales) of the firm itself, the industry to which it belongs, or both."[2] It then plans for adjusting to a level of capital optimum for producing the expected output. Determination of the planned capital stock is only based on output.[3] This principle suggests that technological rigidities permit only one capital-output ratio for one product. That is:

$$I_t = b_1Q_t + b_2Q_{t-1} \qquad 2.6$$

where: $I_t$ = gross investment for period t,

$Q_t$ = output in period t,

$b_1$ = coefficients (expected to be positive).

This model is completed in equation 2.7 with the assumption that replacement investment is proportional to capital stock ($K_{t-1}$) existing at the start of the period. That is,

$$I_t = b_1\ Q_t + b_2Q_{t-1} + b_3K_{t-1} \qquad 2.7$$

---

[1] Jorgenson and Siebert, op. cit., p. 682.

[2] Bischoff, op. cit., p. 16.

[3] The effects of costs of capital, price of investment goods relative to wages, inflation, and various instruments affecting taxes and capital cost allowances are not shown.

Christ[1] found an added expectations variable, lagged investment ($I_{t-1}$), was significant when substituted for lagged output and combined with current output. That is, past investment conditions expectations in the same way past output ($Q_{t-1}$) conditions expectations. This gives:

$$I_t = b_1Q_t + b_3K_{t-1} + b_4I_{t-1} \qquad 2.8$$

where $b_4$ should be positive.

To this generalized flexible accelerator model several other models can be added[2] to reflect a desired level of capital stock. Although rated as less accurate by Bischoff and Jorgenson, the liquidity or cash flow model was shown to be significant by Denton, et al[3], for predicting annual investment by Canadian farmers. In Bischoff's cash flow model, the cash available to invest (E) includes earnings or profits (Z) plus capital cost allowances (Y) plus any tax credits or fast write-off provisions (W) less direct taxes (DT).

---

[1] Carl F. Christ, Econometric Models and Methods (New York: John Wiley and Sons, 1966), p. 584.

[2] See Jorgenson and Siebert, op. cit., pp. 685-686, 704-708 and Bischoff, op. cit., pp. 16-35 for detailed descriptions and ratings of the Neoclassical Model (with or without capital gains) and Federal Reserve MIT - Penn Models. These two are rated superior to the Securities Value or Expected Profits and Liquidity or Cash Flow Models. The first two models are output-oriented and complex. They could not be used for this policy model because of non-linearities and second degree terms. This is unfortunate as they explicitly allow for the tax credits instrument and price changes. Because few firms in the grain handling system have published stock prices, the securities value model was rejected.

[3] Frank T. Denton, D. Freshwater and A.L. Robb, Prices, Incomes, and Capital Formation in Canadian Agriculture (Ottawa, Ontario: Food Prices Review Board, March, 1975), pp. 17-22.

$$E = Z + Y + W - DT \qquad 2.9$$

(E) is substituted for the measure of output (Q). Thus:

$$I_t = b_5E_t + b_6E_{t-1} + b_3K_{t-1} \qquad 2.10$$

Finally, Dernberg and McDougall show that under any one of several conditions, the interest rate can be shown to be effective as an influence on investment decisions. These conditions are: full capacity utilization of resources, low internal firm cash flow, and situations were firms are considering very marginal investments or technologically advanced (high capital) investments.[1] In equation form,

$$I_t = b_1Q_1 + b_3K_{t-1} + b_4I_{t-1} - b_7i_t \qquad 2.11$$

where the sign for $(b_6i_t)$ would be negative.

Using one of these investment equations, the investment behaviour of subsystems will be represented in this study. The policy model is summarized next in Chapter III.

---

[1] Thomas F. Dernberg and D.M. McDougall, Macroeconomics (Toronto: McGraw-Hill, 1963), pp. 98-100.

# CHAPTER III

# SUMMARY OF POLICY MODEL

## Introduction

Chapter III summarizes the conceptual policy model developed piece by piece in the following chapters. The grain handling and transportation System together with its various subsystems are defined in terms of grain flow from farm to port. A convention is described for the words and numbers used to represent the variables. Objectives are introduced, justified, and formulated mathematically. Then the whole model is described with diagrams to aid understanding.

## Definition of Subsystems

Table 3.1 defines the nine subsystems of the grain handling and transportation system as used in this study. The Canadian Wheat Board and Canadian Grain Commission are included as distinct subsystems because they fulfil the guidance functions outlined in Chapter II. The Board and Commission share with provincial and municipal subsystems the environmental linkages identified by Katz; i.e., authoritative, resource, and normative linkages.

Three criteria were used to divide the System[1] into subsystems:

1. Marketing function (like storage, transportation, grading, and selling).

---

[1] The Grains Council and others most frequently refer to only the country elevators, inland terminals, railways and port terminals as the grain handling and transportation system. The broader system for this model will be referred to as the "System".

Table 3.1: Marketing function, asset ownership, and control of export movement by subsystem

| Subsystem Number and Name | Marketing Function | Asset Ownership | Control of Export Movement |
|---|---|---|---|
| 1. Country Elevators | weigh, grade, store load road cars | 9 major primary elevator companies with 2,814 elevator units at 1,594 points | CWB[1] quota and block shipping systems |
| 2. Inland Terminals | dry, clean, store weigh, grade | CGC,[2] Cargill, Weyburn Terminal | CWB quota and block shipping systems |
| 3. Railways | transport | 20-25,000 boxcars moving over 19,300 miles of rail line owned by CNR, CP Rail, and N.A.R. Companies | CWB block shipping systems |
| 4. Port Terminals | official weighing and grading before cleaning storing, and treating for export | 28 terminals at Churchill, Thunder Bay, and Pacific Ports controlled by 9 private firms, CGC and National Harbors Board | CWB controls export shipment, Ship Clearance Association coordinates ship loading |
| 5. Canadian Grain Commission (CGC) | establish and apply final grades, set maximum tariffs charged by #1, 2, 4, licensing of 1,2,4 | Canadian Grain Commissioners appointed by Minister of Agriculture | |
| 6. Canadian Wheat Board (CWB) | manage export sale and direct movement of all grains | Canadian Wheat Board Commissioners under Minister Responsible for CWB | |
| 7. Farm Storage | storage | 166,471 grain producers | 166,471 grain producers responding to CWB quotas |
| 8. Trucking | transportation to subsystem 1 or 2 | Grain producers | individual grain producers, CWB quota |
| 9. Provincial and Municipal Governments | (provides roads and town services) | local and provincial governments in Alberta Saskatchewan and Manitoba | |

[1] CWB Canadian Wheat Board

[2] CGC: Canadian Grain Commission

Source: Canada Grains Council, Statistical Handbook (Winnipeg: Canada Grains Council, 1974), p. 155. (Hereinafter referred to as 1974(b).), also author's definition.

2. Ownership of assets used directly as inputs or outputs to the System (example: trucks, roads).
3. Control or guidance over grain flows or capital alterations to the System (example: Canadian Grain Commission grading).

Each subsystem fulfils one or more functions and is associated with a relatively homogenous group of decision-makers. Farm storage and trucking, although both controlled by farmers, were separated because of their different market function. The functions of terminal and transportation subsystems, by assumption, do not extend eastward beyond Thunder Bay. Seaway shipping, eastern and St. Lawrence Terminals, and ocean shipping were judged as beyond the scope of this study.

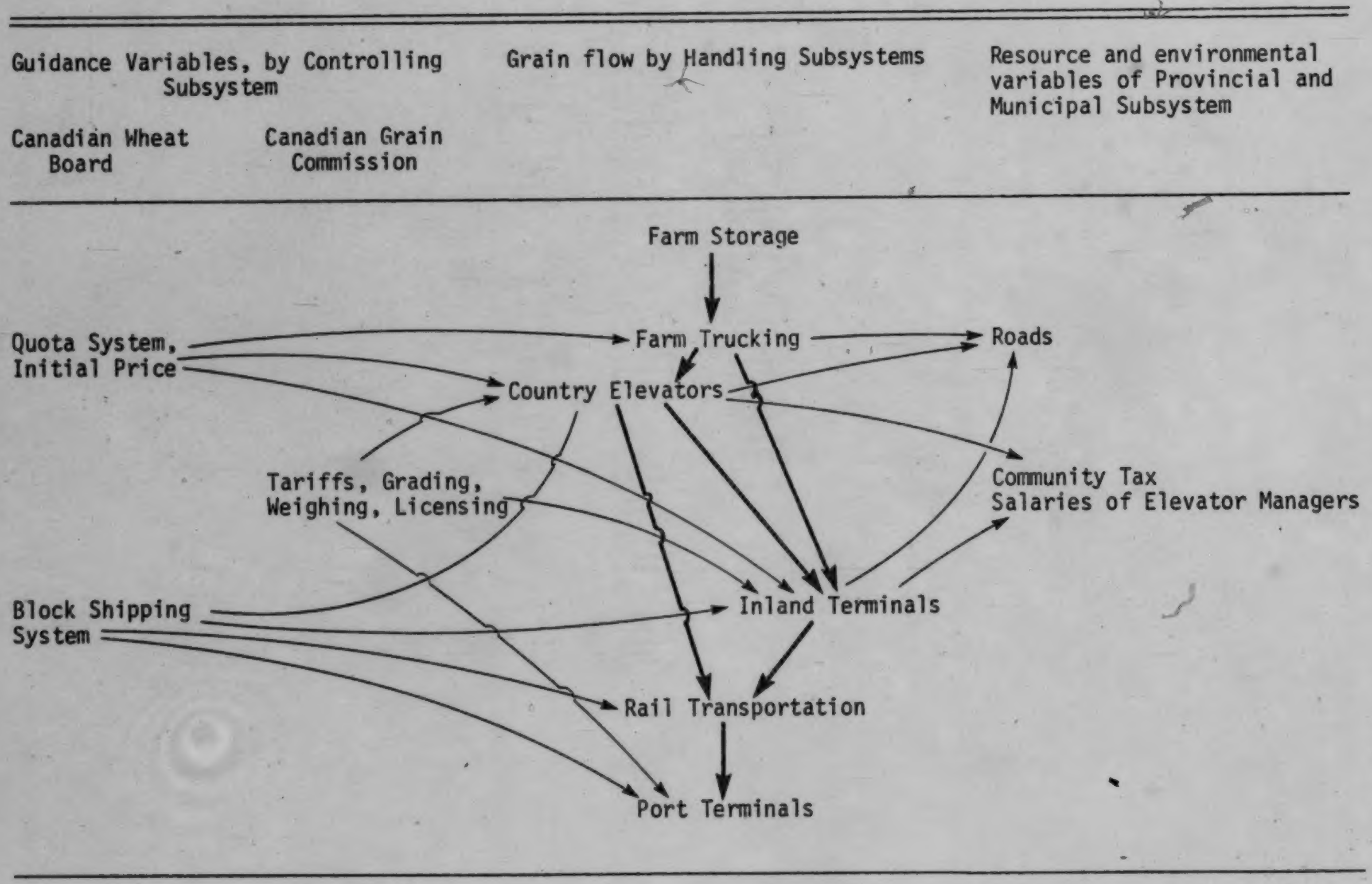
Figure 3.1 clarifies the role and relationship of each subsystem. The flow of grain through the six operational or marketing subsystems is linked to the three guidance or environmental subsystems by variables over which each has decision-making control.

For example, the Wheat Board quota system guides variables in trucking, country elevator and storage subsystems. Similarly, the number and location of country elevators and inland terminals affects road costs of the provincial and municipal subsystems. The example linkages shown in Figure 3.1 will be expanded in later chapters. A method for symbolizing variables is introduced next.

## Symbol Convention For The Model

To simplify comprehension and avoid subscripts and superscripts, this study utilizes a four-digit alpha-numeric convention to identify all variables. This convention, as described below, could be

Figure 3.1: Example linkages between guidance and handling subsystem variables


Guidance Variables, by Controlling Subsystem
Grain flow by Handling Subsystems
Resource and environmental variables of Provincial and Municipal Subsystem
Canadian Wheat Board
Canadian Grain Commission
Farm Storage
Quota System, Initial Price
Farm Trucking
Roads
Country Elevators
Tariffs, Grading, Weighing, Licensing
Community Tax
Salaries of Elevator Managers
Block Shipping System
Inland Terminals
Rail Transportation
Port Terminals

easily programmed for computerized research to quantify the theoretical relationships. It provides for identifying the subsystem with which endogenous and exogenous variables are primarily associated and whether they are target, instrument or important side effect variables. Finally, the nomenclature identifies whether exogenous data variables are current or lagged variables.

The first two digits are alphabetic letters usually taken from the first two letters of a simple one-word variable name or from the first letter of the adjective and first letter of the noun in a multiple word variable name.[1] The third element in a symbol indicates the subsystem involved where i = 1, 2, 3 .... 9, or in some cases i = S to indicate relevance to the total System. For endogenous variables, the third digit indicates the subsystem for which this variable is endogenous. For some exogenous instrument variables identification with one subsystem is unnecessary. Then the third element is filled with an asterisk (*). (Example = SR* = statutory rail rate on grain).

The third and/or fourth place may be vacant if the variable is a data variable associated with no particular subsystem (weather is an example). In many cases, the fourth place takes the values T, S, *, 1, where:

T indicates the variable is a target variable,

S indicates the variable is an important side effect variable,

* indicates the variable is an instrument variable

---

[1] Examples: RC = Realized Costs. IN = Investment.

1 indicates the variable is predetermined from the previous year.

Unless there is a 1 in the fourth digit area, it is assumed the variables are all for the same or "nth" crop year from August 1 to July 31.

For example, (INIS) denotes Investment. That is, endogenous to subsystem one (country elevators) in the current (nth) crop year; the last letter (S) suggests investment is an important side effect variable. Similarly, (NG*) denotes the number of grades of grain, a variable that is selected as an instrument (*).

### Specification of Target and Side Effect Variables In The Model

Objectives for the grain handling and transportation System are translated into three specific, measurable goals and two constraining side effects in the following paragraphs. The generation of estimates of trade-off preferences between goals is left for another study.

#### Target #1: Realized Cost

Both the Grains Group[1] and the Grains Council *State of the Industry* report[2] indicate that the primary objective for the grain handling and transportation system should be to move grain marketed by Western producers from the field to export and domestic positions at the lowest overall cost per bushel. For this model, cost is defined as that cost realized by a subsystem during a year regardless of who finally bears this cost.[1] Realized costs (RCi) for each of i subsystems (where i = 1.....8) are selected as targets RCiT and summed to provide total realized costs per bushel per year (RCST).

---

[1] R.J. Shepp, "Transporation of Western Canadian Grain - Problems and Prospects" (paper presented to Canadian Transportation Research Forum, Winnipeg, May 1970), pp. 13-14.

[2] Canada Grains Council (1973b), *op. cit.*, p. 1.

$$RCST = RC1T + RC2T + RC3T + RC4T + RC5T + RC6T + RC7T + RC8T \qquad 3.1$$

Both RC1T and RC2T are included in 3.1 because conceptually both elevators and inland terminals subsystems realize a cost that should be allocated to each export bushel regardless of whether that bushel actually passed through only one subsystem. The conceptual presentation in 3.1 is made more accurate by 3.1a:

$$RCST = ((TR4)-(IT2))/TR4\,(RC1T) + (IT2/TR4)RC2T + RC3T/TR4 + RC4T + RC5T + RC6T + RC7T + RC8T \qquad 3.1a$$

where:

IT2 = Inland terminal receipts, in millions of bushels,

TR4 = Terminal receipts at ports, in millions of bushels.

Statement 3.1a weights elevator costs (RC1T) and inland terminal costs (RC2T) according to the proportion of total grain movement (TR4) that is flowing through inland terminals (IT2) or elevators (TR4-IT2). Statement 3.1a also converts total railway costs (RC3T) to a per bushel basis by dividing by throughput (TR4). Only 3.1 will be used in the Model in order to simplify conceptual presentation.

---

[1] Realized cost in this study is the same as "system cost" or "costs in resources used" as described in: Kulshreshtha (1975a), op. cit., p. 48, Edward W. Tyrchniewicz and Robert J. Tosterude "A Model for Rationalizing the Canadian Grain Transportation and Handling System on a Regional Basis," American Journal of Agricultural Economics, Vol. 55, No. 5 (1973), pp. 810-811.

Estimates of realized costs in three recent crop years are given in Table 3.2. Since the method of estimation varies somewhat for each element from year to year, only general comparisons between years should be drawn. Realized costs for inland terminals were unavailable. Generally, realized costs dropped from 63.4 cents per bushel in 1969/70 to 55.9 cents per bushel in 1971/72 due to large increases in throughput and reduced marketing costs per unit by the Wheat Board. However, by 1973/74, inflation in elevator and railway costs combined with high Wheat Board marketing costs to push cost up to 84.6 cents per bushel. Some of the increase in Board costs was due to a costly trucking program introduced to overcome System capacity limits.

Table 3.2: Estimated realized costs, per bushel, for 1969/70, 1971/72, 1973/74

| Item | Year<br>1969/70 | <br>1971/72 | <br>1973/74 |
|---|---|---|---|
| Producer Marketings (millions of bushels) | 675 | 950 | 878 |
| Subsystem | | - cents per bushel - | |
| Farm Storage and handling | 5.0 | 5.5 | 6.0 |
| Farm Trucking | 3.2 | 3.7 | 4.9 |
| Country Elevator | 12.4 | 12.2 | 14.0 |
| Railway | 29.9 | 25.5 | 42.9 |
| Port Terminals | 6.9 | 6.1 | 6.8 |
| Canadian Grain Commission Deficit | 0.9 | 0.4 | 0.7 |
| Wheat Board Marketing Costs | 5.1 | 2.5 | 9.3 |
| Total | 63.4 | 55.9 | 84.6 |

Source: Author's estimates as detailed in Appendix A.

## Target #2: Price to Farmers for Services Rendered

The Grains Group suggested the System should "provide the maximum return to the producer ... giving proper consideration to the convenience and cost implications to the producers."[1] Canada Grains Council objectives as presented in the State of the Industry[2] report are similarly stated. In this model, the export price is assumed as exogenously determined. Thus, to maximize returns, the System is defined to be concerned with monitoring the price paid by the farmer (PFi) for services rendered in each of the i subsystems. The sum of all subsystems (PFST), on a per bushel basis, is set as a target variable which is mathematically calculated by:

$$\text{PFST} = \sum_{i=1}^{9} g_i \,(\text{PFi}) \qquad 3.3$$

where $g_i$ = coefficient converting total price of the service in subsystem i to an annual price incident to the farmer, per bushel.

While the farmer eventually pays PFST, the elements of PFST are passed on to farmers in very different forms and at different times. For example, the price of Wheat Board services is reflected in the final payment while the rail rate is reflected in the initial price. To capture all the service costs passed on to the farmer, in the form of a charge for services the conceptual statement (3.3) becomes a more precise accounting statement (3.4).

---

[1] Shepp, op. cit., p. 13.

[2] Canada Grains Council (1973b), op. cit., p.2.

$$\text{PFST} = \text{PF1T} + \text{SR} + \text{HT4} + \text{PF6T} + \text{RC7T} + \text{RC8T} + g_8(\text{NE8}) + g_9(\text{AR9S}) \qquad 3.4$$

where:

PF1T = Price to the farmer for handling and cleaning at country elevators,

SR = Statutory rail rate on grain, in cents per bushel,

HT4 = Handling tariff at the port terminal, in cents per bushel,

RC7T = Realized costs of farm storage, in cents per bushel,

RC8T = Realized costs of farm trucking, in cents per bushel,

$g_8$(NE8) = Net extra cost of trucking due to rail abandonment and inland terminal operations, in dollars per bushel of grain marketed,

NE8 = Net extra costs of trucking, in dollars,

$g_8$ = 1/producer marketings,

$g_9$(AR9S) = Extra taxes paid by farmers (per bushel of grain marketed) as a result of rail line abandonment and inland terminal effects on roads and tax base,

AR9S = Additional realized costs to provincial and municipal governments,

$g_9$ = The proportion of additional costs passed on to farmers.

No price to the farmer is shown for inland terminals as they are currently reflected through the Wheat Board (PF6T). The deficit of the Grain Commission (RC5) is not paid by farmers and hence is excluded from 3.4. Statement 3.4 is the form utilized in the Model to define the sum of the prices paid by the farmer for services rendered.

The level of PFST for known items is shown in Table 3.3. Like Table 3.2, the price of services dropped from 1969-70 to 1971-72. This drop from 39.4 cents per bushel to 38.4 cents was due to (1) reduced storage at country elevators and port terminals and (2) re-

Table 3.3: Estimated price paid by farmers for transporting, handling and marketing wheat from Scott, Saskatchewan to ships at Thunder Bay or Vancouver, 1969-70, 1971-72, 1973-74

| Item | 1969/70 | Year<br>1971/72 | 1973/74 |
|---|---|---|---|
| Volume (millions of bushels) | 675 | 950 | 878 |
| Subsystem | | - cents per bushel - | |
| Farm Storage and Handling | 5.0 | 5.5 | 6.0 |
| Farm Trucking | 3.2 | 3.7 | 4.9 |
| Country Elevator | 17.8 | 10.7 | 14.0 |
| Railway | 13.8 | 13.8 | 13.8 |
| Port Terminals | 8.0 | 6.6 | 7.2 |
| Wheat Board Marketing Cost | 5.1 | 2.5 | 10.5 |
| Less temportary Wheat Reserves Act payments | -13.5 | -4.4 | .0 |
| Total Price paid by Farmers | 30.4 | 38.4 | 56.4 |
| | | - per cent - | |
| Percent of Realized Cost | 62 | 69 | 67 |

Source: Table 3.2; Canada Grains Council, "Grain Handling and Transportation," Fact Sheet No. 2, Winnipeg, Manitoba, 1972, p. 1; Canada Grains Council, Statistical Handbook (Winnipeg: Canada Grains Council, 1975), pp. 200-201. (Hereinafter referred to as 1975(d).)

duced Wheat Board marketing costs. However, Federal subsidies also dropped from 13.5 to 4.4 cents per bushel and hence, stabilized the downswing in price to farmers. The price reflected to farmers increased by 47 percent from 1971-72 to 1973-74 reaching 56.4 cents per bushel. The increase was largely due to inflation in all subsystems, additional storage at port terminals, and the Wheat Board trucking program.

As a rule, farmers pay 60 - 70 percent of the full realized cost. Note that farmers were paying an increased portion (67 percent) of the true System realized costs in 1973-74 as compared to 62 percent in 1969/70.

## Target Variable #3: Effectiveness

Shepp[1] defined "effectiveness necessary to achieve maximum sales" as an objective for the System. In slightly different words, the Canada Grains Council said the grain handling and transportation system should provide that "the required quantities and types of grain are available in position at the required time."[2] Quantification of effectiveness (or speed) and accuracy in filling an export order is difficult. The model uses a proxy goal variable, elapsed time, to measure an element of effectiveness. That is, total time (TTST) for a bushel to move from farmer's ben to ship will, in a crude way, measure the capability of the System to effectively place a bushel at the desired place at the required time. A small TTST reflects increased ability to deliver.

TTST is defined as the sum of time in days an average bushel takes to move through functions in the operational subsystems.

$$TTST = TM1 + TM2 + TM3 + TM4 + TM8 \qquad 3.4$$

---

[1] Shepp, op. cit., p. 13.

[2] Canada Grains Council, (1973b), op. cit., p. 1.

Time as used in this Model is a technical (engineering) measure of the capability of the "pipeline" to move grain. Time consumed to provide handling and transportation functions could be taken from daily operating records of subsystem managers. Bjarnason[1] identified the need for agreement on a basis for rating terminal throughput and made some crude estimates. Techniques of work study[2] or work measurement (like ratio-delay) could be used to trace the time necessary to move grain.

Time (TTST) as used in this Model must be clearly differentiated from "time for storage" (TS). Grain consumes storage time (TS) in the pipeline for other than the transportation, handling, and assembly functions necessary for a smooth flowing sales program. For example, storage time (TS) is incurred because of speculation, maintenance of food reserves, and farm income stabilization (between years). Such waiting time is called storage time (TS) and is not incorporated in TTST or any of its parts. Figure 3.2 separates the time periods referred to in this Model (Shown by a line of H's ) from storage time (signified by a line of S's). Thus, while the hypothetical bushel took 80 days from harvest to the ship, 44 days were consumed in storage (TS) and 36 days in actual handling, assembly, cleaning, and transportation (TTST). Effectiveness is measured by the length of the line of H's, or TTST, which equals 36 in the example.

---

[1] Emil Bjarnason, Operational Aspects of Contractural Arrangements for the Port of Vancouver Terminal Grain Handling and an Exploration of Alternatives (Vancouver: Western Transporation Advisory Council, August, 1975), p. 30.

[2] See for example: International Labor Office, Introduction to Work Study (Geneva, Switzerland: Atar, 1962), pp. 171-197, 289-299.

Figure 3.2: Time chart for handling and transportation (TMST) and for storage (TS) for a hypothetical bushel moving through the system via country elevators, by subsystem

| Subsystem | Grain Activity | Days<br>0 10 20 30 40 50 60 70 80 |
|---|---|---|
| 7 | Time from harvested bushel entering farm storage until Wheat Board quota announced. | SSSSS |
| 8 | Time for decision-making, weather, trucking, queueing and dumping at elevator. | HHHH |
| 1 | Time for: | |
| | a) Elevator receiving, binning, customer service and assembly days to obtain one carload of the grade of grain called by quota. | HH |
| | b) Storage time. | SSSSSSSSSSSSS |
| | c) Time from placement of car order until rail car is loaded. | HHH |
| 3 | Car cycle time from loaded rail car sitting at elevator siding until car reaches the port. | HHHHHH |
| 4 | a) Time to dump grain, clean, grade, and assemble a shipload of one grade. | HH |
| | b) Pure storage time. | SSSS |
| | c) Ship loading time. | H |
| All | Cumulative time for storage (TS = 44 days). | SSSSS SSSSSSSSSSSSS SSSS |
| | Cumulative time for handling (TMST = 36 days). | HHHHHH HHHHHHHHHHH H |

## Inhibiting Conditions on Side Effects

System stakeholders place certain conditions on the System which inhibit movement towards the targets. The first condition[1] is that there should be an incentive "to invest capital in the system, to maintain and upgrade the physical structures and to exploit technology as the need and opportunity arises."[2] Measuring the presence of such an incentive is difficult. The author chose the level of annually induced investment generated by the subsystem as a measure of this incentive. That is, investment for new and replacement structures and equipment is selected as a proxy measurement of the enthusiasm or incentive to exploit technology, and maintain or upgrade the system.

Such investment, symbolized in the ith subsystem by INiS, is introduced to subsystems carrying out marketing functions. INiS is an incidental or indirect result of target levels. When testing policy solutions of the model, INiS would first be left as a flexible endogenous variable. If the levels of INiS were judged too high, the model would be tested again with INiS set at some level.

No statistics could be developed for investment in recent years. In the author's view,an incentive to invest has not existed, especially for the country point and railway subsystems, over the last decade. However investment must be a part of any healthy future system. Presentations to the Hall Commission show substantial capital requirements for both branchlines and country elevators. For example, the Alberta

---

[1] Requiring investment inhibits movement to a lower PFST.

[2] Canada Grains Council, (1973b), op. cit., p. 2.

Wheat Pool estimates[1] a need for $60 million over 10 years to 1985 to upgrade their system of elevators in Alberta. Should there be major reductions in country elevators, additional farm storage and perhaps trucking capability will be needed.

The second inhibiting condition established by stakeholders is that "proper consideration be given to convenience and cost implications to ...the Prairie communities."[2] This concern for side effects of system changes on communities is reflected by a variable called the "additional realized costs to the provincial and municipal government subsystems" (AR9S) (hereafter the word discription is shortened to "additional provincial costs"). AR9S is measured in net present value dollars and defined in depth in chapter X. Levels of AR9S from a policy solution of this Model would be monitored and, if judged too high, the model would be tested again with AR9S set at some lower level than that resulting from the first Model solution. No data could be found to show the levels of AR9S over recent years although chapter X will identify estimates of additional provincial costs resulting from branchline abandonment.

In summary, this study chooses three target variables -- cost, price to farmers, and time -- and limits the movement of the System towards these targets by two conditions: investment should be generated and the additional cost to provincial governments should not be excessive. The model is now introduced.

---

[1] Alberta Wheat Pool, "Brief to the Grain Handling and Transportation Commission," Calgary, Alberta, November, 1975, p. 12. (Mimeo.)

[2] Shepp, op. cit., p. 13.

## The Model

Thirty-six statements or individual models are developed to explain factors affecting the three target summation statements identified in the previous section. Certain assumptions made to construct the Model are outlined below:

1. Wheat, barley, oats, rye, rapeseed, and flaxseed are treated as one homogenous grain movement from farm bins to terminal. Movement into the elevator and forward to terminals is assumed as totally controlled by Wheat Board quota and block shipping systems.

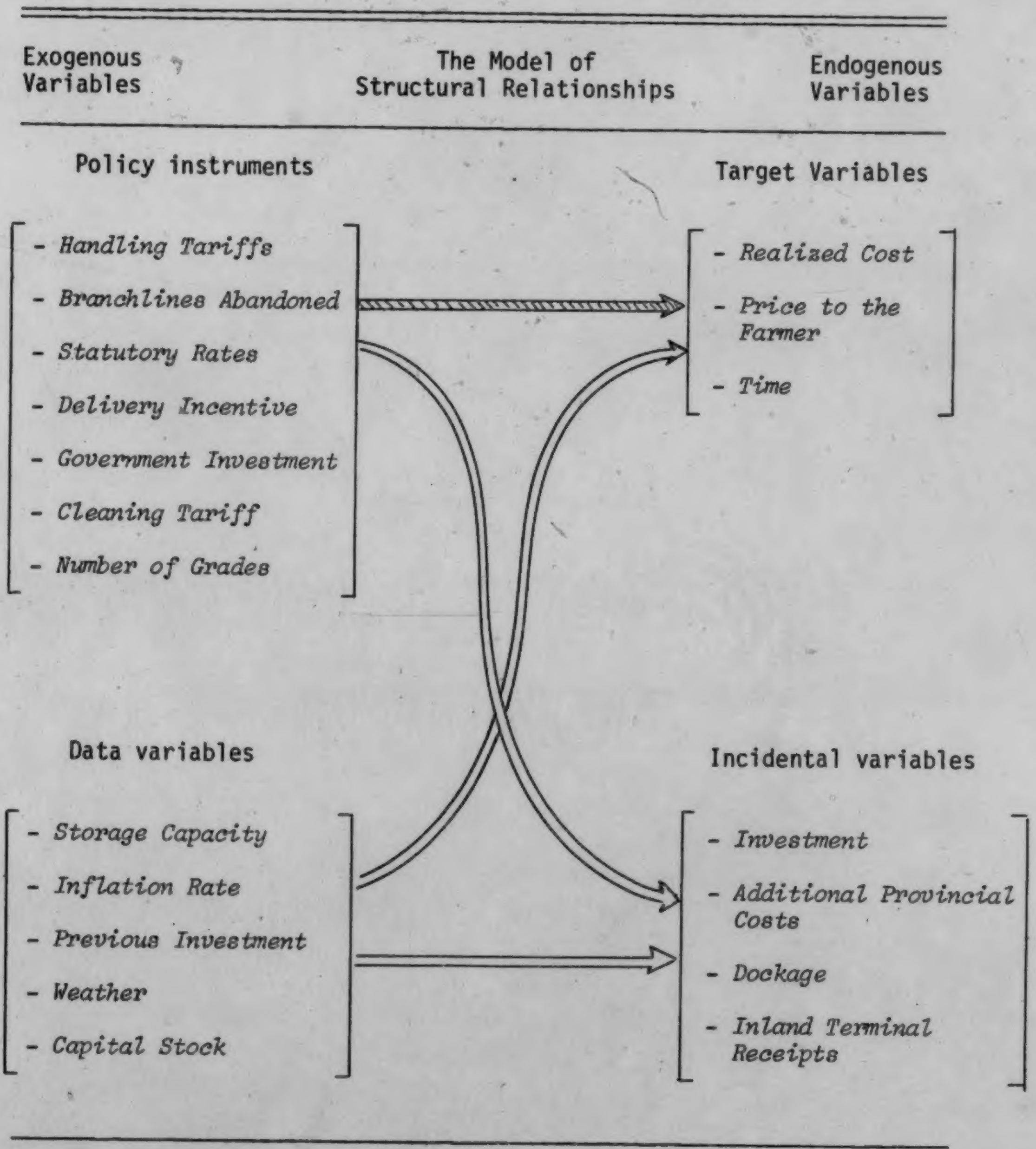
2. Throughout the Model, "bushels net of dockage and excessive moisture" are shortened to "bushels". Foreign matter and excessive moisture in grain are called "dockage" and treated as a separate entity.

3. Unless introduced to a model exogenously, storage levels are assumed to be constant during the crop year and between years. Terminal receipts (TR4) are defined as the common measure of throughput for rail, port terminal, and Wheat Board subsystems.

Figure 3.3 provides a flow chart of the policy connections between variables in the total system. Through the Model instruments in the upper left corner of the figure affect targets in the upper right corner. For example, handling tariffs affect the price to farmers. Instruments have a spill-over effect on incidental variables in the lower right corner (like investment). Uncontrollable or data variables exogenous to the Model (like the inflation rate) also affect targets (like realized costs) and vital side effects (like additional provincial costs).

The Model contains nineteen statements that explain the target variables: nine statements explain various subsystem realized

Figure 3.3: Example of policy relationships of variables in this model of the grain handling and transportation system


Exogenous Variables
The Model of Structural Relationships
Endogenous Variables
Policy instruments
- Handling Tariffs
- Branchlines Abandoned
- Statutory Rates
- Delivery Incentive
- Government Investment
- Cleaning Tariff
- Number of Grades
Target Variables
- Realized Cost
- Price to the Farmer
- Time
Data variables
- Storage Capacity
- Inflation Rate
- Previous Investment
- Weather
- Capital Stock
Incidental variables
- Investment
- Additional Provincial Costs
- Dockage
- Inland Terminal Receipts

costs (RCiT), six statements explain time (TMiT) and four explain price to the farmer (PFit). The other nineteen statements of the model explain incidental or side effect variables and include five investment models and one statement showing the factors affecting the additional cost to provincial governments (AR9S).

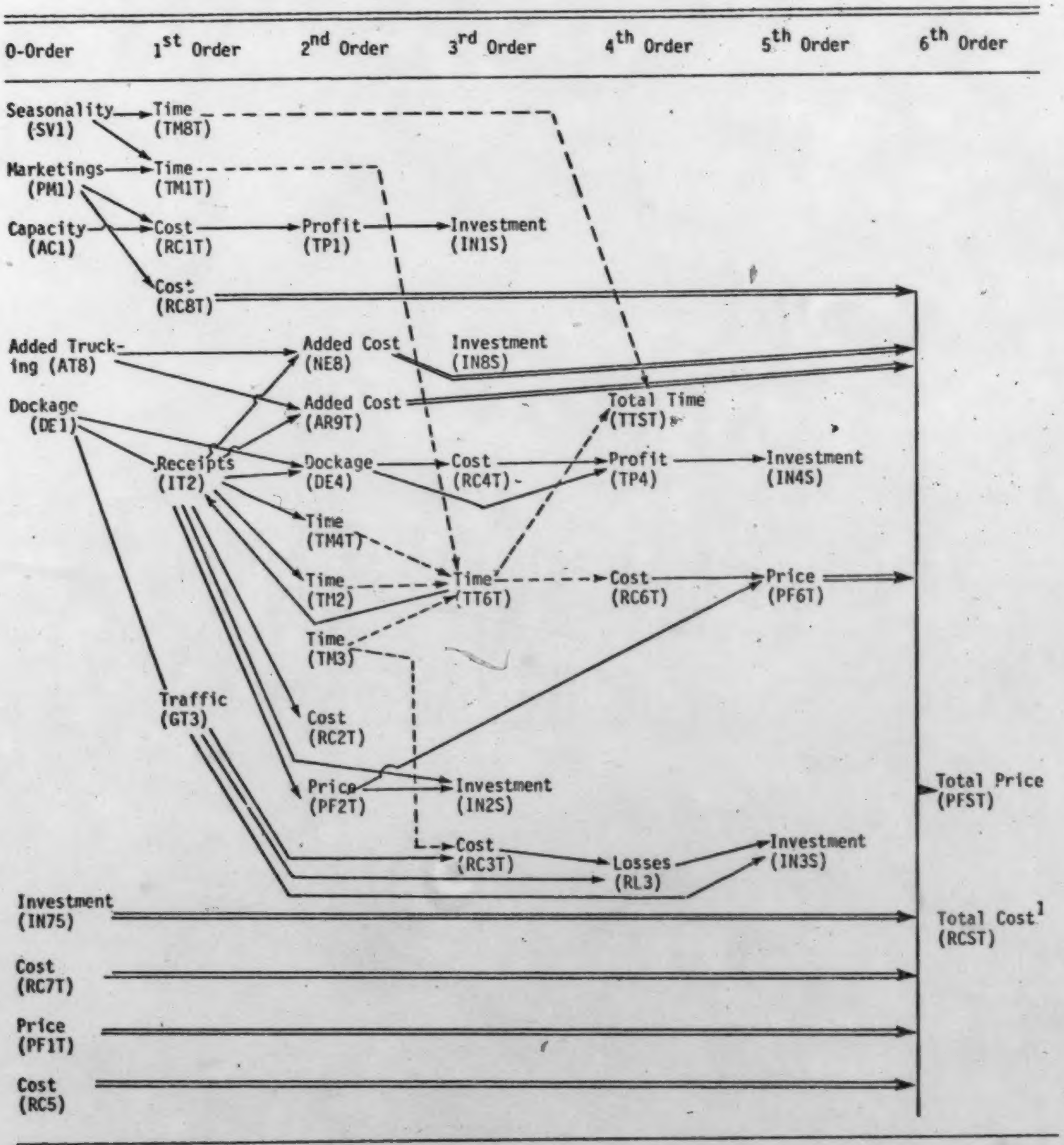
The thirty-nine endogenous variables in the Model are ordered in Figure 3.4 according to their linkage or influence. The concept[1] of ordering large model such as this according to the precidence and casual relations between endogenous variables allows one to see the logical network of impacts of unknown policy variables. For example, variables with order zero (like dockage) are strictly determined by exogenous variables (like weather). Order zero variables have dominant influence over order one variables and drive or determine (along with exogenous variables) the variables in order one, two, three, four, etcetera. Thus the level of dockage entering country elevators ((DE1) = order 0) plays a large part in determining the dockage entering port terminals ((DE4) = order 1). Similarly, the average capacity of elevators (AC1 = order 0) affects or determines the realized cost of elevator operations (RC1T = order 2).

The three summations of System targets are restated in the following section along with a listing of the thirty-six other statements. Statements are listed by subsystem, with accompanying definitions for variables. Variable definitions are expanded and assessed for measurability in later chapters. The number to the right of each statement refers to the chapter and statement number in that chapter. Thus statement 4.2 is the second model found in Chapter IV. Signs below variables indicate the expected direction of influence that the variable will have on the dependent, endogenous variables.

---

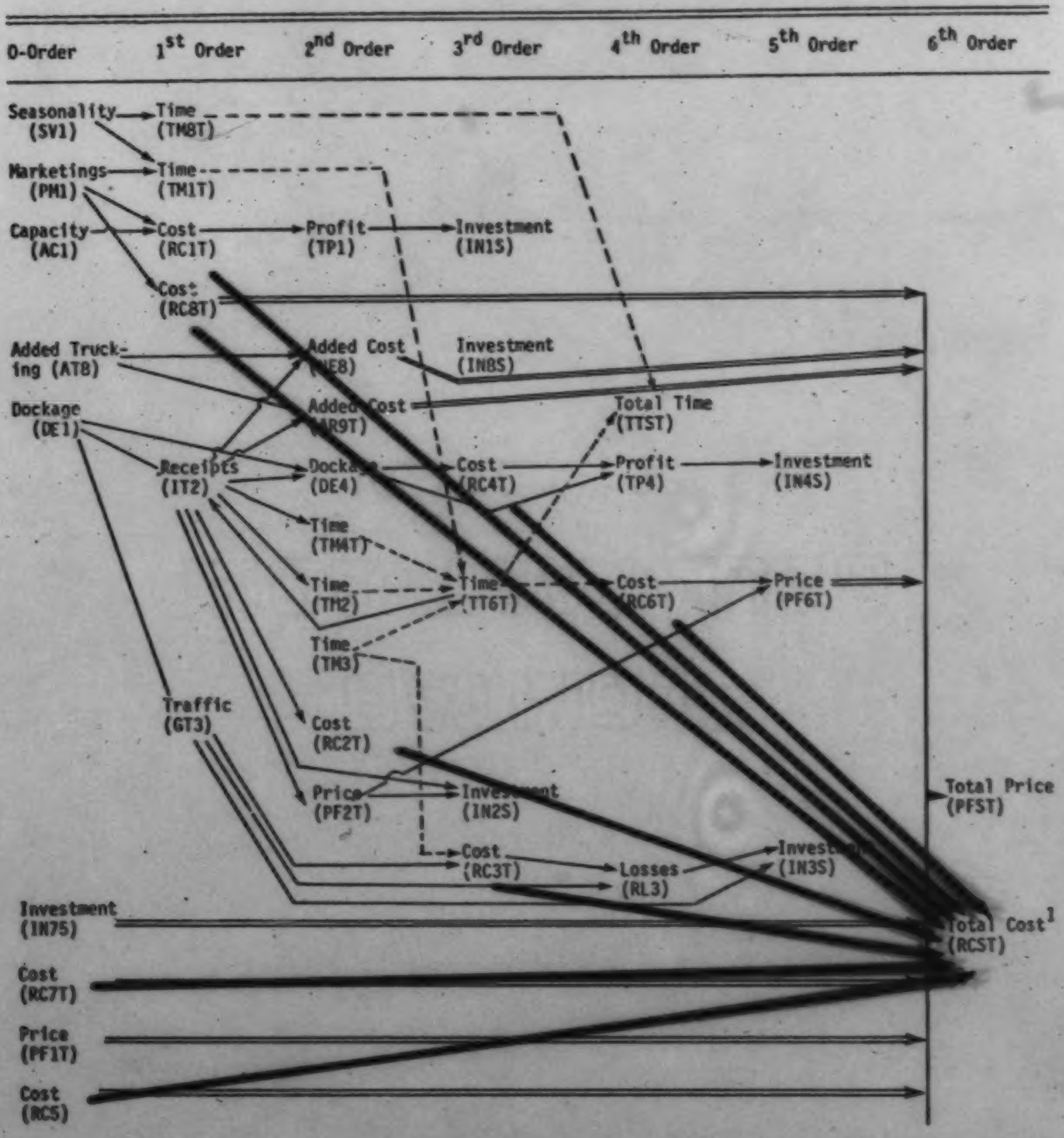
[1] Fox, et. al., op. cit., pp. 65-71, 332-339.

Figure 3.4: Linkages or causal ordering of endogenous variables


0-Order
1st Order
2nd Order
3rd Order
4th Order
5th Order
6th Order
Seasonality (SV1)
Time (TM8T)
Marketings (PM1)
Time (TM1T)
Capacity (AC1)
Cost (RC1T)
Profit (TP1)
Investment (IN1S)
Cost (RC8T)
Added Trucking (AT8)
Added Cost (NE8)
Investment (IN8S)
Dockage (DE1)
Added Cost (AR9T)
Total Time (TTST)
Receipts (IT2)
Dockage (DE4)
Cost (RC4T)
Profit (TP4)
Investment (IN4S)
Time (TM4T)
Time (TM2)
Time (TT6T)
Cost (RC6T)
Price (PF6T)
Time (TM3)
Traffic (GT3)
Cost (RC2T)
Price (PF2T)
Investment (IN2S)
Total Price (PFST)
Cost (RC3T)
Losses (RL3)
Investment (IN3S)
Investment (IN75)
Total Cost[1] (RCST)
Cost (RC7T)
Price (PF1T)
Cost (RC5)

[1] Factors determining RCST are represented on accompanying overlay.

Figure 3.4: Linkages or causal ordering of endogenous variables


0-Order
1st Order
2nd Order
3rd Order
4th Order
5th Order
6th Order
Seasonality (SV1)
Time (TM8T)
Marketings (PM1)
Time (TM1T)
Capacity (AC1)
Cost (RC1T)
Profit (TP1)
Investment (IN1S)
Cost (RC8T)
Added Trucking (AT8)
Added Cost (AE8)
Investment (IN8S)
Added Cost (AR9T)
Dockage (DE1)
Total Time (TTST)
Receipts (IT2)
Dockage (DE4)
Cost (RC4T)
Profit (TP4)
Investment (IN4S)
Time (TM4T)
Time (TM2)
Time (TT6T)
Cost (RC6T)
Price (PF6T)
Time (TM3)
Traffic (GT3)
Cost (RC2T)
Price (PF2T)
Investment (IN2S)
Total Price (PFST)
Cost (RC3T)
Losses (RL3)
Investment (IN3S)
Investment (IN75)
Total Cost[1] (RCST)
Cost (RC7T)
Price (PF1T)
Cost (RC5)

---

[1] Factors determining RCST are represented on accompanying overlay.

## Target Statements

$$RCST = RC1T + RC2T + TC3T + RC4T + RC5T + TC6T + RC7T + RC8T \qquad 3.1$$

$$PFST = PF1T + SR + HT4 + PF6T + RC7T + RC8T + g_8(NE8) \cdot g_9(AR9S) \qquad 3.4$$

$$TTST = TM1 + TM2 + TM3 + TM4 + TM8 \qquad 3.5$$

Subsystem #1: Country Elevators

$$\text{DE1} = f(\underset{+}{\text{HW}}, \underset{-}{\text{DP}}, \underset{-}{\text{CT1*}}, \underset{+}{\text{PM1}}) \qquad 4.1$$

$$\text{SV1} = f(\underset{+}{\text{QV6*}}, \underset{-}{\text{DI1}}, \underset{+}{\text{TW}}, \underset{-}{\text{UP}}) \qquad 4.2$$

$$\text{PM1} = f(\underset{+}{\text{IP*}}, \underset{+}{\text{TR4}}, \underset{-}{\text{FP}}, \underset{-}{\text{SV1}}, \underset{-}{\text{DE1}}) \qquad 4.3$$

$$\text{AC1} = f(\underset{-}{\text{NE}}, \underset{+}{\text{MB*}}) \qquad 4.4$$

$$\text{RC1T} = f(\underset{-}{\text{PM1/NE}}, \underset{+}{\text{AC1}}, \underset{+}{\text{IR}}) \qquad 4.5$$

$$\text{TM1T} = f(\underset{+}{\text{PM1}}, \underset{+}{\text{SV1}}, \underset{-}{\text{HT1/SC}}, \underset{+}{\text{NG}}) \qquad 4.6$$

$$\text{TP1} = \text{PM1}\,(\text{HT1*} + \text{CT1*} + \text{TM1T}\,(\text{SC*}) - \text{RCIT}) + (\text{SC*})(\text{ST1*}) - \text{DI1} \qquad 4.7$$

$$\text{PFIT} = \text{HT1*} + \text{CT1*} - (\text{DI1})/(\text{PM1}) - p(\text{TP11})/\text{PM1} \qquad 4.8$$

$$\text{IN1S} = f(\underset{+}{\text{TP1}}, \underset{+}{(1-p)\,(\text{TP11})}, \underset{+}{\text{IN11}}, \underset{+}{\text{TC*}}) \qquad 4.9$$

where (alphabetically stated):

AC1 = Average Capacity

CS11 = Capital Stock

CT1* = Cleaning Tariff

DE1 = Dockage

DI1 = Delivery Incentives

DP = Dockage Price

FP = Feed Price

HT* = Handling Tariff

HW = Harvest Weather

IN11 = Past Investment

IN2S = Investment

IP* = Initial Price

(1-p) (TP11) = Retained Patronage Dividend

IR = Inflation Rate

MB* = "B" Lines Abandoned

NE = Number of Elevators

NG* = Number of Grades

PF1T = Price to Farmer

PM1 = Producer Marketings

PM1/NE = Average Receipts

p(TP11)/PM1 = Patronage Dividend refunded

QV6* = Quota Variation

RCIT = Realized Cost

SC*(ST1*) = Storage Revenue

SV1 = Seasonal Variation

TC1* = Tax Credit

TM1T = Time

TP1 = Total Profit

TP11 = Profit in previous year

TR4 = Terminal Receipts

TW = Total Weather

UP = Utilization of Pacific Ports

Subsystem #2: Inland Terminals

$$IT2 = f\ (\underset{+}{TR4}, \underset{+}{DE1}, \underset{-}{HT2^*}, \underset{+}{DI2^*}, \underset{+}{NB}, \underset{+}{TT6T}) \qquad 5.1$$

$$RC2T = f\ (\underset{-}{IT2}, \underset{+}{IC2}, \underset{+}{IR}) + DI2/IT2 \qquad 5.2$$

$$TM2 = z\ (\underset{+}{IT2})/(TR4) \qquad 5.3$$

$$PF2T = HT2^* - DI2/IT2 \qquad 5.4$$

$$In2S = f\ (\underset{+}{IT2}, \underset{+}{IN21}, \underset{-}{PF2/PF1}, \underset{+}{NF7}, \underset{+}{CR3^*}, \underset{+}{CR2^*}) \qquad 5.5$$

where:

CR2 = Credit Available

CR3 = Change in Rail Rate Structure

DE1 = Dockage

DI2 = Delivery Incentives

FF2/PF1 = Price Ratio

$HT2^*$ = Handling Tariff

IC2 = Storage Capacity

In21 = Past Investment

IN2S = Investment

IR = Inflation Rate

IT2 = Inland Terminal Receipts

NB = Non-Board Grain

NF = Net Farm Income

z = Days Removed from Rail Car Cycle

RC2T = Realized Cost

TM2 = Time Saved

TR2 = Port Terminal Receipts

TT6T = Time by Other Subsystems

Subsystem #3: Railways

$$GT3 = f\ (\underset{+}{DE1} + \underset{+}{TR4}) \tag{6.1}$$

$$TM3T = f\ (\underset{+}{ST4^{*}},\ \underset{+}{TW},\ \underset{+}{LD},\ \underset{+}{NE}) - TM2 \tag{6.2}$$

$$RC3T = f\ (\underset{+}{GT3},\ \underset{+}{TM3T},\ \underset{+}{CC3^{*}},\ \underset{-}{MB^{*}},\ \underset{+}{IR}) + IC3^{*} \tag{6.3}$$

$$RL3 = RC3T - (GT3)\ (SR^{*}) + BS3 - d(GI31) \tag{6.4}$$

$$IN3S = f\ (\underset{+}{GT3},\ \underset{+}{CS31},\ \underset{+}{CC3^{*}},\ \underset{-}{RL3}) + GI3^{*} \tag{6.5}$$

where:

$BS3$ = Branchline Subsidies

$CC3^{*}$ = Cost of Capital

$CS31$ = Capital Stock

$DE1$ = Dockage

$d(GI31)$ = Cost of Hopper Car Operations

$GI3^{*}$ = Government Investment

$GT3$ = Grain Traffic

$IC3^{*}$ = Institutional Costs

$IN3S$ = Investment

$IR$ = Inflation Rate

$LD$ = Labor Disruptions

$MB^{*}$ = Miles of "B" Line Abandoned

$NE$ = Number of Elevators

$RC3T$ = Realized Cost

$RL3$ = Railway Losses

$SR^{*}$ = Statutory Rate

$ST4^{*}$ = Storage Stocks

$TM2$ = Time Saved

$TM3T$ = Time

$TR4$ = Terminal Receipts

$TW$ = Weather

Subsystem #4: Port Terminals

$$DE4 = f\left(\underset{+}{TR4},\ \underset{-}{IT2},\ \underset{-}{CT4^*},\ \underset{+}{DE1}\right) \qquad 7.1$$

$$RC4T = f\left(\underset{-}{TR4},\ \underset{+}{DE4},\ \underset{+}{TE4},\ \underset{+}{IR},\ \underset{+}{NG^*}\right) \qquad 7.2$$

$$TM4T = f\left(\underset{+}{ST4^*},\ \underset{+}{DE4},\ \underset{+}{LD},\ \underset{-}{IT2}\right) \qquad 7.3$$

$$TP4 = (ST4^*)\,(SC) + (HT4^*)\,(TR4) + (BP)\,(DE4) - RC4T \qquad 7.4$$

$$IN4S = f\left(\underset{+}{TP4},\ \underset{+}{CS41},\ \underset{+}{IN41},\ \underset{+}{SI4^*}\right) \qquad 7.5$$

where:

BP = By-Product Price

$CT4^*$ = Cleaning Tariff

DE1 = Dockage Entering Elevator

DE4 = Dockage

$HT4^*$ = Handling Tariff

IN4S = Investment

IR = Inflation Rate

LD = Labor Disruptions

NG = Number of Grades

RC4T = Realized Cost

SC = Storage Charge

$SI4^*$ = Storage Incentive

ST4 = Storage Stocks

TE4 = Terminal Storage Capacity

TM4T = Time

TP4 = Total Profit

TR4 = Terminal Receipts

## Subsystem #5: Canadian Grain Commission

$$RC5T = f\ (\underset{-}{TR4}, \underset{+}{IR}) \qquad 8.1$$

where:

IR = Inflation Rate

RC5T = Realized Costs

TR4 = Terminal Receipts

## Subsystem #6: Canadian Wheat Board

$$TT6T = (TM1T - w_1) - TM2 + k(TM3T) + TM4T \qquad 8.2$$

$$RC6T = f\ (\underset{+}{TT6T}) \qquad 8.3$$

$$PF6T = w_2(ST2 + ST4^*) + (IT2/TR4)\ (PF2) + RC6T \qquad 8.4$$

where:

IT2 = Inland Terminal Receipts

k = Proportion of Days Cars are Full

PF2 = Price to Farmer

PF6T = Price to Farmer

RC6T = Realized Cost

ST2 = Stocks in Elevators

$ST4^*$ = Stocks in Port Terminals

TM2 = Time Saved by Inland Terminal

TM3T = Time in Rail Cars

TM4T = Time in Terminal

TR4 = Terminal Receipts

TT6T = Total Wheat Board Time

$w_1$ = Free Period

$w_2$ = Parameter

## Subsystem #7: Farm Storage

$$IN7S = f \ (\underset{+}{NF7 + TC7^{*}}), \underset{+}{NF71}, \underset{+}{YR}) \qquad 9.1$$

$$RC7T = f \ (CS71 \underset{+}{+} s(IN7S), \underset{+}{(DE1)/(PM1)}, \underset{+}{PC7}, \underset{?}{FS}, \underset{+}{NG}) \qquad 9.2$$

where:

CS71 = Capital Stock

DE1 = Dockage

FS = Farm Size

IN7S = Investment

NF7 = Net Farm Income

NF71 = Past Net Farm Income

NG = Number of Grades

PC7 = Percent Carryover

PM1 = Producer Marketings

RC7T = Realized Cost

$TC7^{*}$ = Tax Credit

YR = Year

Subsystem #8: Trucking

$$RC8T = f\ (\underset{-}{NE},\ \underset{-}{(PM1/FM)},\ \underset{+}{IR}) \tag{9.3}$$

$$AT8 = f\ (\underset{+}{MB^*}) \tag{9.4}$$

$$NE8 = f\ (\underset{+}{AT8},\ \underset{+}{IT2},\ \underset{-}{DI1},\ \underset{-}{DI2},\ \underset{-}{CO^*}) \tag{9.5}$$

$$TM8T = f\ (\underset{-}{(IP^*/FP)},\ \underset{+}{TW},\ \underset{+}{SV6},\ \underset{+}{NF7}) \tag{9.6}$$

$$IN8S = f\ (\underset{+}{NF7},\ \underset{+}{NF71},\ \underset{+}{YR},\ \underset{+}{NE8}) \tag{9.7}$$

where:

AT8 = Additional Trucking

$CO^*$ = Compensation

DI1 = Delivery Incentive

DI2 = Delivery Incentive

FM = Number of Permit Holders

FP = Feed Price

IN8S = Investment

IP = Initial Price

IR = Inflation Rate

IT2 = Inland Terminal Receipts

MB = Miles of "B" Line Abandoned

NE = Number of Elevators

NE8 = Net Extra Trucking Cost

NF7 = Net Farm Income

NF71 = Past Net Farm Income

PM1 = Producer Marketings

RC8T = Realized Cost

SV6 = Seasonality

TM8T = Time

TW = Weather

YR = Year

## Subsystem #9: Provincial and Municipal Governments

$$AR9S = f\,(NE2,\ MB,\ AT8) + (d(IT2),\ IR,\ SV1) \tag{10.1}$$

where:

AR9S = Additional Provincial Costs

AT8 = Additional Trucking Due to Rail Abandonment

d(IT2) = Trucking to Inland Terminals

IR = Inflation Rate

MB = Miles of "B" Line Abandoned

NE = Number of Elevators

SV1 = Seasonal Variation

## Summary

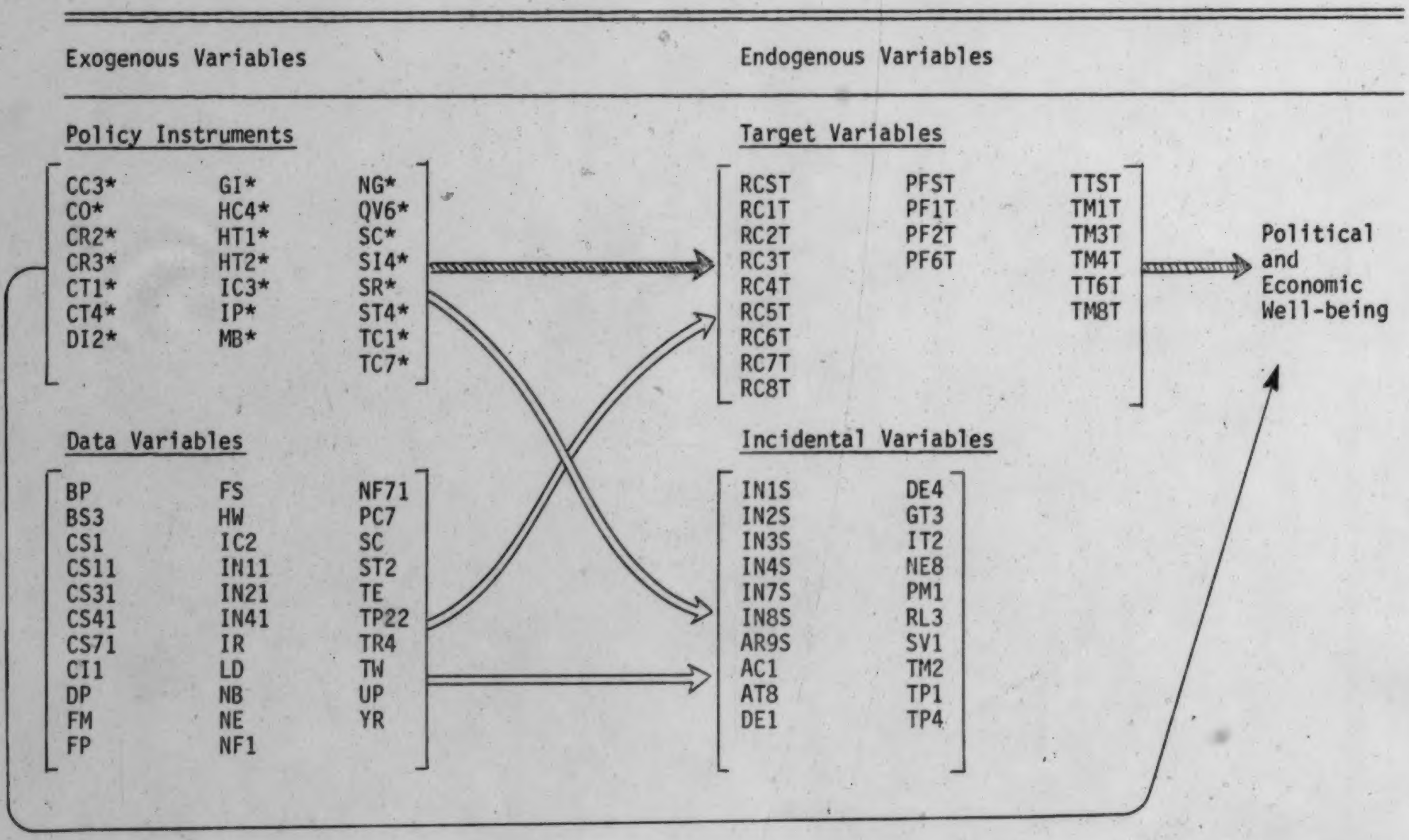
The Model contains thirty-nine endogenous variables and fifty-four exogenous variables. Variables are classified in Figure 3.5 according to the policy classification developed in chapter II.

Each of the 22 quantitative instruments is grouped in the upper left, in alphabetical order with an asterisk in the right hand element. For example CC3* is the cost of capital instrument affecting subsystem three. The target variables are grouped in the upper right area of Figure 3.5 in three columns. Column one shows that there are realized cost target variables in subsystems #1 to #8 plus a summation variable expressing the total System target. Column two shows the four price to farmer targets and column three lists the six time targets. The total set of targets contributes to political and social well-being.

Less important variables are shown in the lower portion of Figure 3.5. In the lower left area the 32 exogenous, data variables are listed alphabetically. The six investment conditions (INiS) and additional costs to provincial governments (AR93) are the most vital of the 20 endogenous, incidental variables in the lower right.

The logic behind each statement and the measureability of variables are discussed by subsystem in Chapters IV to X. Policy instruments are also evaluated in each chapter. Chapter XI will draw together the Model and deal with broader policy implications.

Figure 3.5: Exogenous And Endogenous Variables In The Model


Exogenous Variables
Endogenous Variables
Policy Instruments
CC3*
CO*
CR2*
CR3*
CT1*
CT4*
DI2*
GI*
HC4*
HT1*
HT2*
IC3*
IP*
MB*
NG*
QV6*
SC*
SI4*
SR*
ST4*
TC1*
TC7*
Data Variables
BP
BS3
CS1
CS11
CS31
CS41
CS71
CI1
DP
FM
FP
FS
HW
IC2
IN11
IN21
IN41
IR
LD
NB
NE
NF1
NF71
PC7
SC
ST2
TE
TP22
TR4
TW
UP
YR
Target Variables
RCST
RC1T
RC2T
RC3T
RC4T
RC5T
RC6T
RC7T
RC8T
PFST
PF1T
PF2T
PF6T
TTST
TM1T
TM3T
TM4T
TT6T
TM8T
Incidental Variables
IN1S
IN2S
IN3S
IN4S
IN7S
IN8S
AR9S
AC1
AT8
DE1
DE4
GT3
IT2
NE8
PM1
RL3
SV1
TM2
TP1
TP4
Political
and
Economic
Well-being

# CHAPTER IV

# COUNTRY ELEVATOR SUBSYSTEM

## Introduction

Country elevators purchase and grade grain from farmers' trucks, then they store, assemble into carlots, and load grain into railway cars. For the purpose of this Model, the manager unit will be used as the measure of country elevators. That is, one "country elevator unit" owned by a firm at a point may have two or more elevators and there may be several competitive elevator manager units at one country point.

Performance measures or targets selected for subsystem #1 (country elevator units) include:

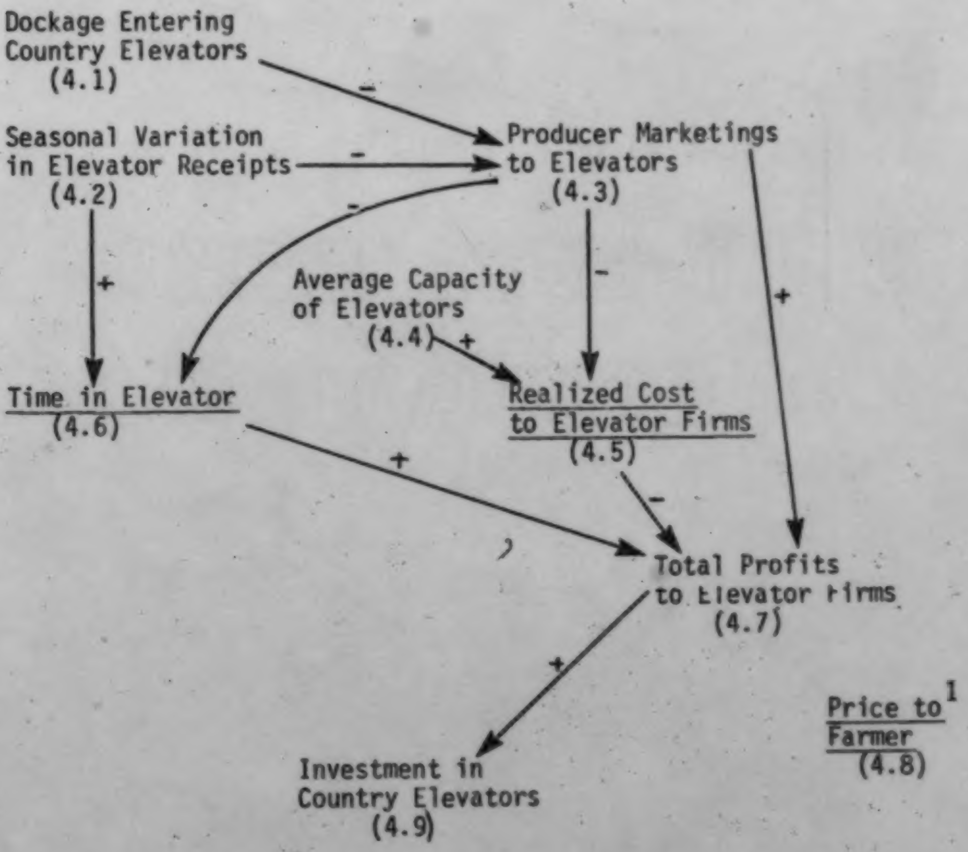
1. Realized cost to the elevator subsystem (RC1T).
2. Time in the elevator subsystem (TM1T).
3. Price to farmers for services rendered by the subsystem (PF1T).
4. Total profits to elevator firms (TP1T).

Investment in country elevator facilities (IN1S) is introduced as a condition inhibiting movement toward the RC1T and PF1T targets.

The chapter develops nine structural or functional relationships. Many are estimable by regression techniques. These functional forms are interrelated as shown in Figure 4.1. Numbers under a variable name refer to the explanatory statement or functional form developed in the chapter. Arrows relate the logical flow of influence or causality; signs show the direction (positive or negative) of that influence.

For example, Figure 4.1 shows that as dockage increases, space for and therefore the level of producer marketings decreases. An increase in producer marketings will result in decreased realized costs per bushel. Target variables are underlined to clearly identify them to the reader.

Figure 4.1: Logical relationships among variables endogenous to country elevator subsystem (#2)


Dockage Entering Country Elevators (4.1)
Seasonal Variation in Elevator Receipts (4.2)
Producer Marketings to Elevators (4.3)
Average Capacity of Elevators (4.4)
Realized Cost to Elevator Firms (4.5)
Time in Elevator (4.6)
Total Profits to Elevator Firms (4.7)
Price to Farmer (4.8) 1
Investment in Country Elevators (4.9)
-
-
-
+
-
+
+
+
-
+

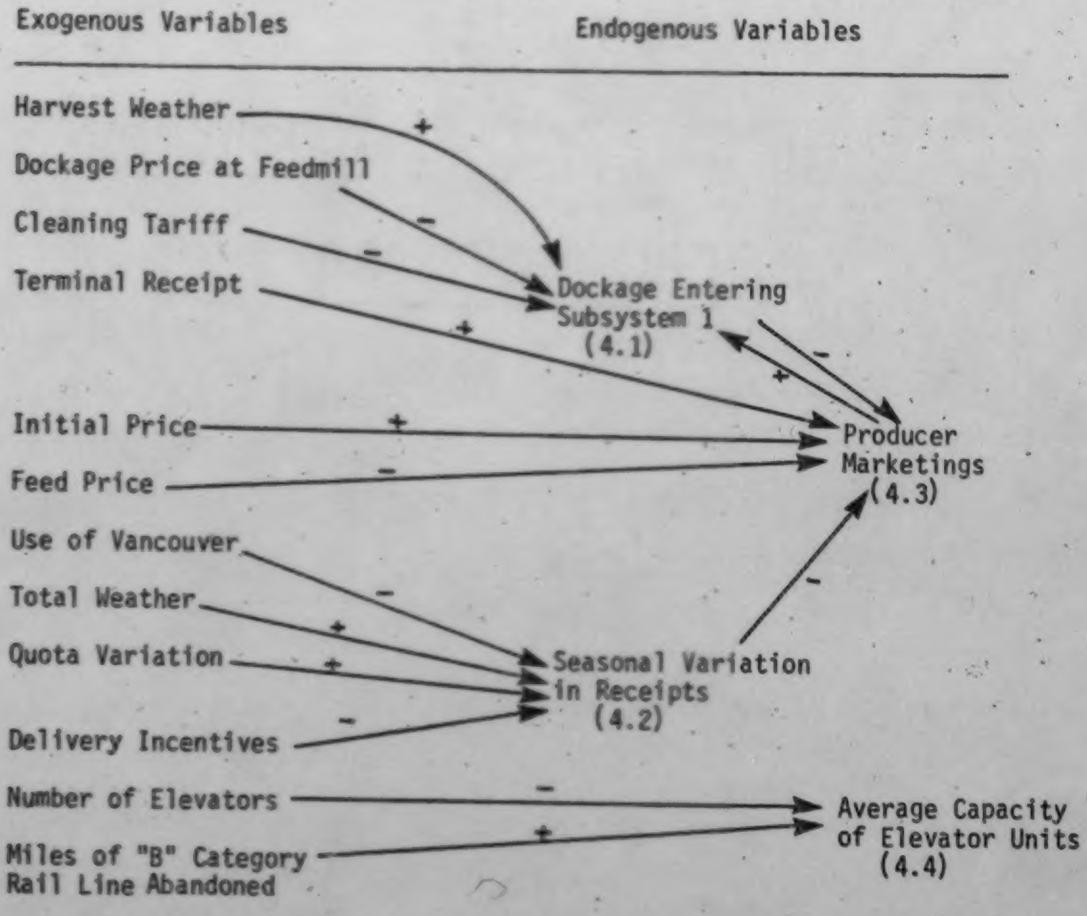
---

[1] The Price to Farmer is determined only by exogenous variables not shown in this figure.

## Structural Relationships Involving Non-Target Variables

Figure 4.2 schematically portrays the logic of the four incidental variables introduced in statements 4.1 (Dockage), 4.2 (Seasonal Variation in Receipts), 4.3 (Producer Marketings), and 4.4 (Average Capacity of Elevator Units). Each incidental variable is used to determine the level of one or more target variables entered in the chapter.

Figure 4.2: Logical relationships affecting incidental variables in country elevator subsystem (#1)


Exogenous Variables
Endogenous Variables
Harvest Weather
+
Dockage Price at Feedmill
–
Cleaning Tariff
–
Terminal Receipt
+
Dockage Entering Subsystem 1 (4.1)
–
+
Initial Price
+
Feed Price
–
Producer Marketings (4.3)
Use of Vancouver
–
Total Weather
+
Quota Variation
+
Delivery Incentives
–
Seasonal Variation in Receipts (4.2)
–
Number of Elevators
–
Miles of "B" Category Rail Line Abandoned
+
Average Capacity of Elevator Units (4.4)

Dockage

$$DE1 = f\ (\underset{+}{PM1},\ \underset{-}{CT1},\ \underset{-}{DP},\ \underset{+}{HW}) \tag{4.1}$$

where:

DE1 = Dockage entering country elevators during a year, in millions of pounds,

PM1 = Producer marketings to primary elevators, in millions of bushels (net of dockage), per year,

CT1 = Cleaning tariff, in cents per bushel,

DP = Dockage price as measured by the average #2 feed [illegible]rley price on the Prairies, per bushel,

HW = Harvest weather, in millions of acre-inches of precipitation.

Dockage (screenings, weed and foreign grain seeds) and moisture which enter country elevators demand special care to maintain grain quality. Dockage requires additional space and therefore costs in elevators and rail cars. For example, dockage shipped to terminals in the 1969-70 crop year was estimated[1] to require 12,000 freight cars or 33 rail cars per day.

Statement 4.1 is a basic supply function for a derived product; it could be estimated from time series data.[2] Statement 4.1 hypothesizes that the volume of dockage will vary primarily as the volume of producer marketings (PM1). Dockage will decrease as the cleaning tariff (CT1) is raised since the tariff acts as a deterrent.

---

[1] "Dockage Costs Money," Agri-News (Alberta Department of Agriculture News Release), January 8, 1973.

[2] To the author's knowledge, data are only available on dockage shipments from country elevators. Data for the dependent variable, dockage entering elevators, could be estimated by multiplying the percentage of dockage in grain shipments during a year times the producer marketings entering in a year: i.e., DE1 = (% dockage in shipments) (producer marketings of grain to elevators). Dennis Kennedy, Assistant Director, Economics and Statistics Division, Canada Grain Commission, Interview, April 27, 1976.

Similarly, the supply of dockage to the elevators will vary inversely as the price (DP) of its substitute use in livestock feed. Finally, the author's farm experience suggests the amount and geographic extent of rainfall during harvest will directly affect the total foreign matter and moisture in grain. Such a weather effect could be measured by (a) multiplying a region's precipitation (in inches) during fall periods by the seeded acreage in that region and (b) summing over all regions in the Prairies. Farm expenditure on weed chemical was rejected as an explanatory factor in 4.1 because annual measurement of such expenditures is difficult.[1]

### Seasonal Variation in Receipts

$$SV1 = f\ (\underset{+}{QV6}, \underset{-}{DI1}, \underset{+}{TW}, \underset{-}{UP}) \tag{4.2}$$

where:

SV1 = Seasonal variation in producer marketings to elevators as measured by the coefficient of variation for monthly marketings,

QV6 = Quota variation as measured by the coefficient of variation of (quota level in a month) x (acreage to which the quota applies),

DI1 = Delivery incentives paid by elevator firms, in thousands of dollars,

TW = Total weather influence from August to June 1 as measured by inches of precipitation times area of Prairies and B.C. associated with grain handling,

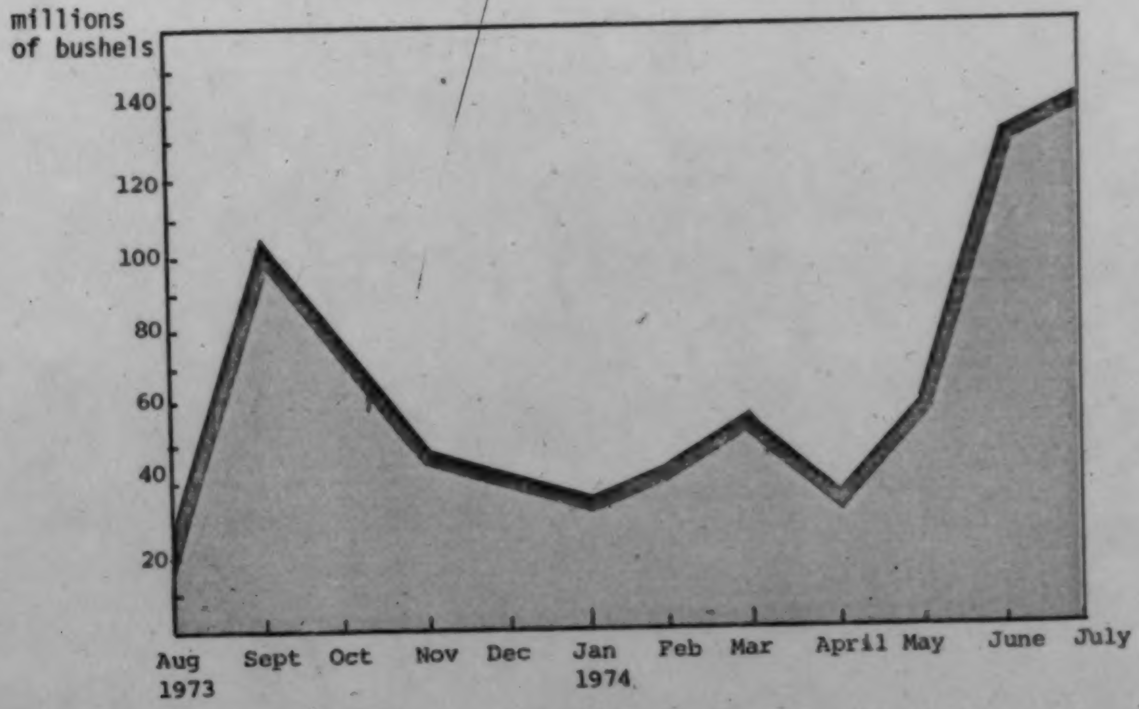
UP = Utilization of Pacific ports as measured by the percent of total grain export clearances going through Vancouver and Prince Rupert.

---

[1] Further information on dockage considerations can be found in: Canada Grain Council, An Assessment of Selected Studies in Grain Handling and Transportation (Winnipeg: Canada Grain Council, 1973), pp. 85 - 97. (Hereinafter called (1973 a).)

Figure 4.3 shows the wide swings in producer deliveries over the twelve month shipping season. The pattern of larger volumes at the end of each season is persistent from year to year for two reasons. First, the high fall deliveries arise because farmers wish to deliver straight from the combine to elevators in order to reduce their on-farm storage needs. The summer peak is due in part to the farmer using farm storage as a buffer to stabilize his income. That is, the farmer keeps his grain until he is sure, from an inspection of his current crop, that drought, hail, and other crop considerations will not lower his future income to an extent where he should retain last year's crop. If the crop is good, the farmer then delivers more

Figure 4.3: Producer deliveries by month (all grains)
crop year 1973-74



Source: Canadian Wheat Board, Annual Report, 1973-74. (Winnipeg, Manitoba: Canadian Wheat Board, p. 38.

grain to the elevator.

The second reason for the higher summer deliveries in Figure 4.3 is that Thunder Bay can ship grain only during ice-free summer and fall months and therefore much of the Thunder Bay grain is forwarded during the summer. The pattern of Figure 4.3 as measured by seasonal variation (SV1) is a vital variable since the unevenness of flow restricts the maximum capacity of the grain "pipeline" -- rail cars, for example, may be underutilized in the winter and in tight supply in mid-summer.

There are, in the author's view, some variables that can explain variations in SV1 from year to year. First, as the use of the year-round Pacific ports (UP) increases, one would expect the influence of Thunder Bay shipping to decrease. Secondly, the level and timing of Wheat Board quotas is a major factor determining when farmers deliver. Quotas for specific grains are issued several times a year simultaneously to all farmers delivering to a grain block. For example, quota A for five bushels of wheat may open September 1 and run until December 31; quota B for an additional five bushels of wheat may open November 1 and run until February 28. Therefore, the level of total delivery opportunity on the Prairies at any one time is the product of quota times the number of acres it applies to (example: 5 bushels x 1 million acres = 5 million bushels opportunity). The variation in delivery opportunity can be measured by the coefficient of variation (QV6) of delivery opportunity from month to month. It is hypothesized that a lower QV6 (less quota variation) will reduce the seasonality of producer deliveries.

Delivery incentives (DI1) do not as a rule exist for country elevators but are introduced in the model to show their possible effect in reducing seasonal delivery variation (SV1). Delivery incentives could take two forms: reduced elevator handling tariffs and trucking premiums. Currently, the Canada Grain Act, administered by the Canadian Grain Commission, permits "one or more (elevator) plants in a class to charge a rate for services different than that charged by other plants of the same class and operated by the same company."[1] This does not go far enough according to the Canada Grains Council:[2]

> If the regulated tariffs allowed greater latitude, the elevator companies could offer rate advantages to producers who delivered to more efficient, higher volume facilities, who delivered at certain times of the day or week, etc. The existing level of rates have not left sufficient room for negotiation with the producer.

Cargill sees the additional need for trucking premiums so large grain handling facilities can realize the economics of large volumes.[3] The author concludes DI1 is a variable that the industry wishes to examine. DI1 measures in thousands of dollars the reduced income to elevators (from lower handling tariffs) plus increased expenditures (trucking premiums to attract large volumes to points during low volume periods). The author suggests in 4.1 that as delivery incentives increase, seasonal variation declines.

---

[1] H.D. Pound, "Plain Facts About Grain Handling and Storage Tariffs," Proceedings of the Grain Handling and Transportation Seminar (Canada Grains Council, March, 1973), p. 27.

[2] Canada Grains Council (1975 b), op. cit., p. 45.

[3] Cargill, "Submission to the Grain Handling and Transportation Commission" (presented in Winnipeg, Manitoba, October 1975), pp. 25 - 26. (Mimeographed.)

The Canadian Wheat Board reports[1] indicate that substantial precipitation on Prairie roads and branchlines or on mountain passes disrupts the Board's desired rail shipping program and farm deliveries. Total weather (TW) is introduced to explain this disruptive seasonal effect. TW would be calculated for each year in a similar way to harvest weather (HW).

Producer Marketings

$$PM1 = f\,(\underset{+}{IP}, \underset{+}{TR4}, \underset{-}{FP}, \underset{-}{SV1}, \underset{-}{DE1}) \tag{4.3}$$

where:

PM1 = Producer marketings to primary elevators, in millions of bushels (net of dockage), per year,

IP = Initial price per bushel f.o.b. Lakehead less average freight adjustment,

TR4 = Terminal receipts at Churchill, Thunder Bay and Pacific ports, in millions of bushels,

FP = Feed price on the Prairies, per bushel, as measured by the average non-Board price.

Statement 4.3 is a supply function for grain deliveries to elevators (PM1). PM1 would be expected to vary according to price (IP) and the price in the competitive feed market (FP). Volumes going into elevators (PM1) will vary as the demand for grain as measured by volume shipped out of elevators. Shipments from elevators are assumed to be all by rail car and destined for ports. Hence, elevator shipments equal terminal receipts (TR4). TR4 is used as the measure of elevator shipments or market demand in statement 4.3.

---

[1] Canadian Wheat Board, Annual Reports (Winnipeg, Manitoba: CWB, 1972-73, 1973-74), both p. 45.

Two additional variables will have a small effect on PM1. SV1 is introduced to 4.3 as a measure of the grain pipeline's capacity limitations. A lower SV1 would mean an evener grain flow and hence less congestion at elevators and better rail car utilization. Thus, if seasonal variation dropped, ceterus paribus, the system could receive more farm deliveries (PM1) in a year. Similarly, high dockage volumes will reduce the capacity of elevators by taking up valuable space. Hence, in years of high DE1, PM1 (net of dockage) would be slightly reduced.

Net farm income may have a large effect on when, and to what level, farmers sell grain. One would expect farmers' deliveries to drop as their income becomes so high that they wished to postpone income tax by not delivering. Net income was omitted from 4.3 because[1] of its correlation with IP and TR4.

Average Capacity of Elevator Units

$$AC1 = f(\underset{-}{NE}, \underset{+}{MB}) \qquad 4.4$$

where:

AC1 = Average storage capacity of all elevator units, in thousands of bushels,

NE = Number of elevator units,

MB = Miles of "B" category rail lines abandoned.

Table 4.1 shows that as the number of elevator operating units declines, the average capacity per unit increases. Hence, the inverse relationship between NE and AC1 in 4.4. While wholesale rail abandonment has not taken place in recent years, the mandate of the Grain Handling and Transportation Commission includes recommending line abandonment. If rail line abandonment decisions primarily remove smaller elevators and cause the building of bigger elevators, the mileage of abandonment (reflected by MB) will vary directly as average capacity (AC1).

---

[1] The effect of income on PM1 may have been reduced in recent years with increased cash advances and regulations permitting deferral of grain income into the next year.

Table 4.1: Elevator units and average storage capacity, 1970/71 to 1974/75.

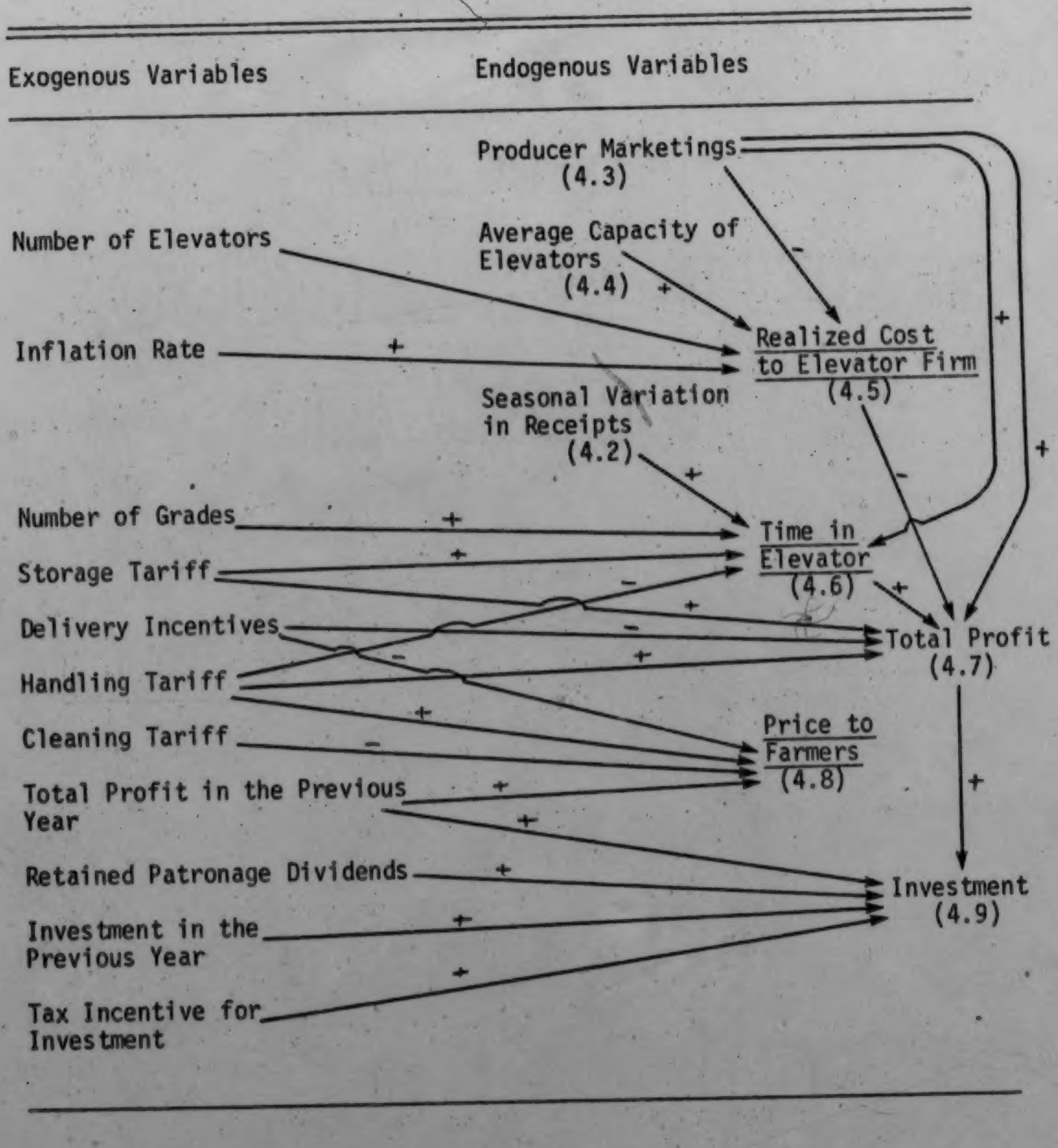
| Year | Number of Elevator Units | Average Capacity per Unit (thousands of bushels) |
|---|---|---|
| 1970/71 | 3539 | 112,681 |
| 1971/72 | 3477 | 113,314 |
| 1972/73 | 3240 | 116,604 |
| 1973/74 | 2814 | 128,739 |
| 1974/75 | 2623 | 135,519 |

Source: Canada Grains Council, State of the Industry (Winnipeg: CGC, 1973), Exhibit 4A.; Canada Grains Council, Statistical Handbook (Winnipeg: CGC, 1974, 1975), p. 155; p. 185.

## Structural Relationships Involving Target Variables

Figure 4.4 outlines the flow of logic for the five structural relationships introduced to the model in statements 4.5 (Realized Cost), 4.6 (Time in Elevator), 4.7 (Total Profits), 4.8 (Price to Farmers), and 4.9 (Investment).

Figure 4.4: Logical relationships affecting target variables in country elevator subsystem (#1)



Exogenous Variables
Endogenous Variables
Producer Marketings (4.3)
Number of Elevators
Average Capacity of Elevators (4.4)
Inflation Rate
Realized Cost to Elevator Firm (4.5)
Seasonal Variation in Receipts (4.2)
Number of Grades
Storage Tariff
Time in Elevator (4.6)
Delivery Incentives
Handling Tariff
Total Profit (4.7)
Cleaning Tariff
Price to Farmers (4.8)
Total Profit in the Previous Year
Retained Patronage Dividends
Investment (4.9)
Investment in the Previous Year
Tax Incentive for Investment
+
−

Realized Cost

$$RC1T = f\ (\underset{-}{PM1/NE},\ \underset{+}{AC1},\ \underset{+}{IR}) \qquad 4.5$$

where:

RC1T = Realized cost per bushel to elevator subsystem, in dollars,

PM1/NE = Average receipts in bushels per elevator unit as derived from the quotient of total producer marketings (PM1) divided by the number of elevators (NE),

IR = Inflation rate expressed as an index.

The per bushel realized cost (RC1T) in an average elevator is defined to include all costs less delivery incentives (DI1). In their Area Eleven Study, the Canada Grains Council estimated part of 4.5 to be:[1]

Log average total cost per bushel in dollars
= 0.34720 - 0.59815 log of receipts in bushels
+ 0.39371 log capacity in bushels.

Thus a 1 percent increase in receipts reduces average costs per bushel by 0.60 percent while a 1 percent increase in capacity increases costs by 0.39 percent. The Council later escalated these estimates[2] to allow for inflation. Consequently, the Grains Council estimation techniques can be conceptually represented by 4.5 where PM1/NE provides, from other variables in the model, the receipts in an average elevator.

---

[1] Canada Grains Council, Area Eleven Study (Winnipeg: Canada Grains Council, 1975), p. 75. (Hereinafter (1975 a).)

[2] Canada Grains Council, Information Booklet, Booklet for Area 14 (Winnipeg: Canada Grains Council, 1975), pp. 85 - 86. (Hereinafter (1975 c).)

Time in the Elevator

$$\mathrm{TM1T} = f\ (\underset{+}{\mathrm{PM1T}},\ \underset{+}{\mathrm{SV1}},\ \underset{-}{\mathrm{HT1/SC}},\ \underset{+}{\mathrm{NG}}) \tag{4.6}$$

where:

TM1T = Time in the elevator subsystem, in days,

HT1 = Handling tariff, in cents per bushel,

SC = Storage tariff per bushel per day, established by the Canada Grain Commission (subsystem #5),

NG = Number of grades of grain as established by the Canada Grain Commission.

TM1T is defined to include the time necessary to receive and bin grain in an elevator, serve customers, assemble a carload of grain of one type, and load grain on a rail car. Although work study data are not currently available for TM1T, a cross-sectional survey of elevators done quarterly over several years could easily estimate TM1T, PM1T, and NG in effect at each elevator. By 4.6 the author hypothesizes that:

1. TM1T in an elevator increases if producer marketings (PM1) increase since congestion and slowdowns result.

2. TM1T increases if seasonal variation (SV1) increases since bottlenecks arising from an uneven flow raise overall throughput time.

3. TM1T decreases when the ratio of handling to storage revenue (HT1/SC) increased because the revenue from additional time in the elevator will be relatively less profitable than handling another bushel.

4. TM1T in an elevator will increase if there are many grain types in that elevator. For example, an elevator in Southern Alberta receiving primarily wheat will take less time to assemble carloads than an elevator in Northern Alberta receiving the full range of grades of

wheat, oats, barley, and rapeseed. In a similar way, increasing the number of grades (NG) of grain[1] will increase TM1T. For example, adding protein segregation in wheat will increase the time necessary to assemble a carload of a particular protein content.

Total Profits

$$TP1 = PM1(HT1 + CT1 + TM1T(SC) - RC1T) + (SC)(ST1) - DI1 \quad 4.7$$

where:

TP1 = Total profits of elevator companies, in millions of dollars,

HT1 = Handling tariff, in cents per bushel,

TM1T(SC) = Storage revenue per bushel as a result of handling time, in cents per bushel,

(SC)(ST1)= Storage revenue, in millions of dollars, as a result of normal storage where ST1 = storage in elevators, in millions of bushels.

Statement 4.7 is an accounting summation of total profit. Revenues include handling revenue (PM1)(HT1), cleaning revenue (PM1)(CT1) and storage revenue from normal stocks (SC)(ST1) plus handling (PM1)(SC)(TM1T). Realized costs (RC1T) and total new delivery incentives (DI1) are then subtracted from revenues to yield total profits.

---

[1] The author defines (NG) as a proxy for introducing cost and time economies by changes to the total grading system. The number of grades is used here for measurement simplicity. Protein segregation and new grades for utility wheats are now under review by the Standards Committee of the Canada Grain Commission. While each new grade more accurately reflects quality both to buyer and seller, there is a definite operational cost to the System. Increased foreign matter tolerance in export grades will have the same effect on time and cost as reducing (NG). For additional discussion, see: Canada Grains Council, "Sub-Committee Report on Market Specifications for Canadian Grains," Winnipeg, Manitoba, April, 1976. (Mimeographed.)

Price to Farmers

$$PF1T = HT1 + CT1 - p(TP11)/PM1 - DI1/PM1 \tag{4.8}$$

where:

PF1T = Price to farmers per bushel for services rendered by the elevator system,

p(TP11)/PM1 = Patronage dividend refunded per bushel where TP1T = total profit in the previous year and g = proportion of profits distributed to shareholders.

This accounting statement indicates a farmer pays, upon delivery of his grain, a handling and cleaning tariff (HT1 + CT1). If delivery incentives (DI1) are paid, the farmer on average will deduct from the tariffs a per bushel incentive (DI1/PM1). Over three-quarters of Prairie grain is delivered to cooperatives who usually declare a patronage refund on a per bushel basis. While this happens approximately one year after delivery, farmers usually discount this mentally and calculate "if I deliver to the Pool, I receive "x" cents per bushel more". This behavior is represented conceptually in 4.8 by p(TP11)/PM1.

Investment

$$IN1S = f\ (\underset{+}{TP1},\ \underset{+}{(1-p)TP11},\ \underset{+}{IN11},\ \underset{+}{TC}) \tag{4.9}$$

where:

IN1S = Investment in country elevators by all firms, in millions of dollars,

(1-p)TP11 = Retained patronage dividends, in millions of dollars,

IN11 = Investment in country elevators in the previous year, in millions of dollars,

TC = Tax credit for investment, in thousands of dollars of taxes saved.

The rationale for this investment functional form is developed in statement 2.10. That particular investment model was chosen because grain cooperatives, who make up over 50 percent of the elevator system, rely very heavily on retained earnings (1-p)(TP11) to determine investment. The previous year's investment by the industry (IN11) would appear to have a positive demonstration effect. The cash available variable (E) in 2.10 is divided into current profits (TP1) plus tax credits (TC) in 4.9.

Although Fast[1] showed abandonment of branchlines positively affected investment on nearby lines, abandonment was not reflected in 4.9. Abandonment may have its greatest effect on the location rather than on the level of investment predicted by 4.9.

## Policy Implications

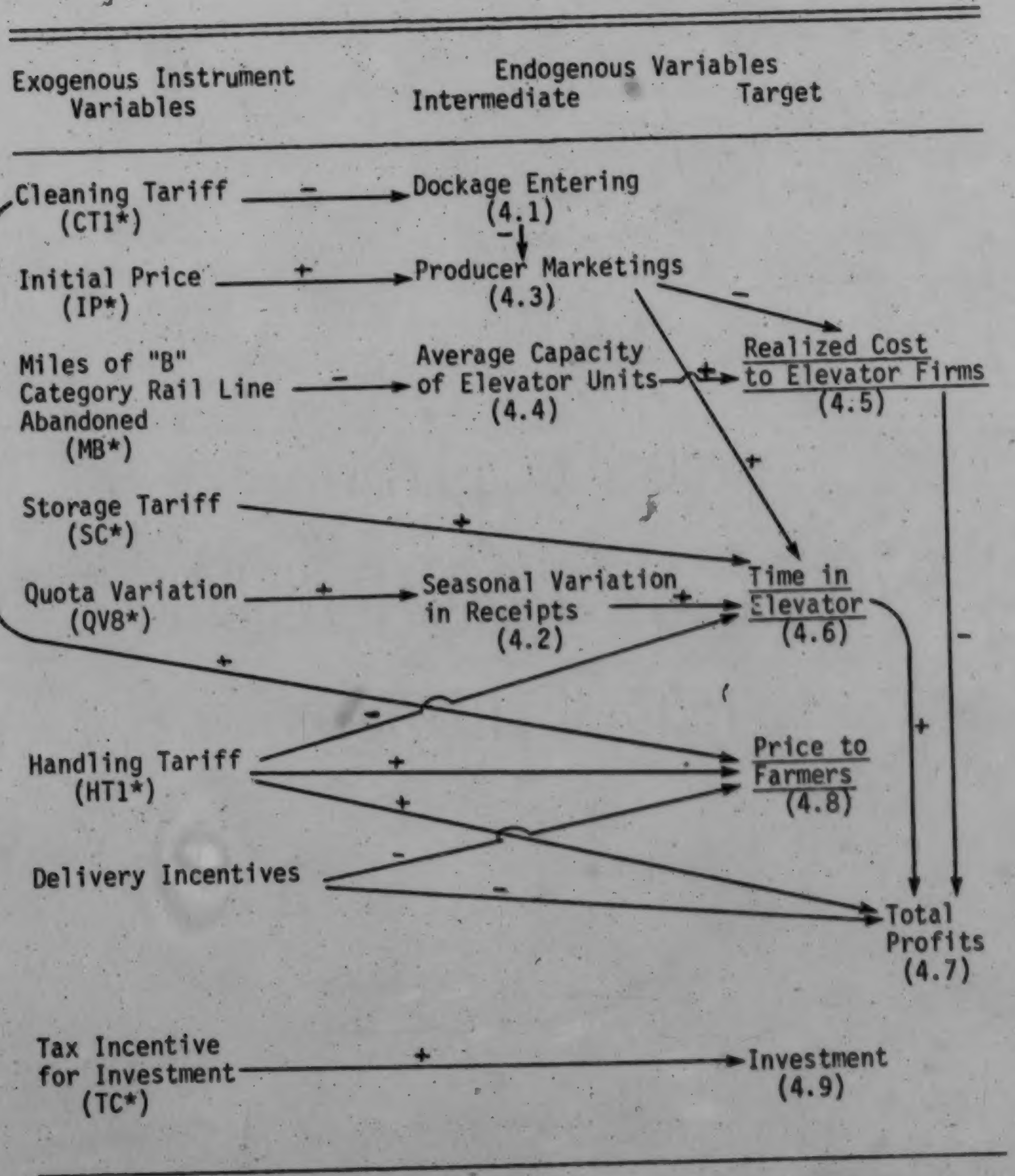
### Instrument Selection

Many of the nine models or functional forms contain exogenous variables which can be influenced or controlled by centralized decision-makers in government or government agencies like the Canada Grain Commission and Canadian Wheat Board. Seven "controllable" exogenous variables are selected as instruments capable of steering the system towards the targets. The instrument - target linkages are summarized in Figure 4:5.

---

[1] Henry R. Fast, "Changing Communities in Rural Saskatchewan," Canadian Farm Economics, Volume 7, No. 2 (1972), p. 12.

Figure 4.5: Instrument - target linkages selected for elevator Subsystem (#1)


Exogenous Instrument Variables
Endogenous Variables
Intermediate
Target
Cleaning Tariff (CT1*)
–
Dockage Entering (4.1)
–
Initial Price (IP*)
+
Producer Marketings (4.3)
–
Miles of "B" Category Rail Line Abandoned (MB*)
–
Average Capacity of Elevator Units (4.4)
+
Realized Cost to Elevator Firms (4.5)
+
Storage Tariff (SC*)
+
Quota Variation (QV8*)
+
Seasonal Variation in Receipts (4.2)
+
Time in Elevator (4.6)
–
+
–
Handling Tariff (HT1*)
+
Price to Farmers (4.8)
+
+
Delivery Incentives
–
–
Total Profits (4.7)
Tax Incentive for Investment (TC*)
+
Investment (4.9)

The cleaning tariff (CT1) is selected as an instrument (CT1$^*$) in statement 4.1 because it is highly visible (on the producer's certificate) as a deterrent to dockage and because it indirectly affects the realized cost target (RC1T). An increase in the cleaning tariff in 4.1, 4.3, and 4.5 brings a reduction in cost (RC1T). However, dockage is only a small proportion of producer marketings (averaging 2.5 percent). Cleaning tariffs also have a sensitive upper limit after which farmers would invest in their own cleaning equipment. Thus, CT1$^*$ has limited influence and a constrained range of possible values.

Quota variation (QV6) is selected in model 4.2 as an instrument (QV6$^*$) preferable to the use of Pacific ports (UP) because variation in quota within a year is more open to direct Wheat Board control than is Board influence on the shipping market in its choice of Pacific or Eastern ports. Quota signals are also, in the author's view, the most effective intra-crop year signals to cause grain to move into elevators. QV6$^*$ also influences TM1T in a complementary way in 4.6. When coupled with adequate publicity and moral suasion, as was used in the fall of 1975, a quota change can smooth out interseasonal variation, attract a smoother, larger flow of producer marketings and hence increase elevator profits (4.7). Also, QV6$^*$ contains flexibility in that it is really a composite of twelve monthly choices about an instrument level when other variables involve one choice in effect for a whole year.

The author's choice of the initial price level as an instrument (IP$^*$) to encourage producer marketings reflects the existing policy of the Wheat Board. In this subsystem, an increase in $IP^*$ directly increases producer marketings (4.3) and then indirectly reduces realized costs (4.5) and time (4.6). $IP^*$ is simple to administer: set in advance of the crop year by the March announcement of quota and price levels, $IP^*$ can be changed during the year with an adjustment payment. However, the range of values $IP^*$ can take to attract PM1 is constrained by the financial reality that the grain pool (of the Wheat Board) must be solvent. That is IP* must be less than the export price less marketing costs.

Both the miles of "B" category line (MB) and the number of elevators licensed (NE) have a direct effect on elevator capacity, which determines 40 percent[1] of the variation in RC1T. To date, elevator licensing (NE) by the Canada Grain Commission has been automatic but the author believes the Canada Grain Act permits the Commission to tell firms to close down points in order to reduce system costs. While licensing is a simple, inexpensive, once per year choice, using the licensing activity to remove elevators would have considerable political repercussions from farmers and elevator firms directed at the Canada Grain Commission. Therefore, this model rejects NE as an instrument capable of being steered by government agencies.

Reducing the miles of "B" category line (MB) and hence, increasing average elevator capacity, seems in 1976 to be a more timely and politically acceptable instrument than NE so it is selected as an instrument ($MB^*$) to reduce elevator numbers and costs (RC1T).

---

[1] See the coefficient of the elevator capacity variable discussed in conjunction with equation 4.5 on realized cost.

The handling tariff (HT1) is selected as an instrument (HT1*) because of its simple and direct effect on TM1T, PF1T and its indirect effect on IN1S. HT1* is already set annually as a maximum by the Canadian Grain Commission. Currently HT1* = 12 cents per bushel. Most elevator units charge something less - approximately 9.5 cents. While reducing HT1* can reduce PF1T in the short run, the author favors raising HT1* beyond the current maximum in order to encourage the competitive and more flexible provision of delivery incentives that can compensate for longer delivery distances to larger, less costly elevator units. That is, in the balancing relationship 4.8, higher HT1* permits larger DI1 at any given level of the price to farmers for elevator services.

The delivery incentive variable is rejected as an "instrument" because trucking incentive payments by elevators to farmers are really not controllable by the government agencies involved except by the existing, permissive Canada Grain Commission tariff structure mentioned previously. Delivery incentives are, however, subject to influence by the level of the handling tariff and by persuasion or public debate on the use of incentives as exemplified by the Hall Commission hearing process. DI1 is included in Figure 4.5 for illustrative purposes. A higher HT1*, while increasing PF1T through 4.8, also permits a reduction of PF1T by bringing increased revenue to a farm and permitting payments of trucking incentives (DI1) that reduce PF1T.

The storage tariff (SC) and number of grades (NG) are controllable by the Canada Grain Commission. By 4.6 both SC and NG affect time in the elevator. (NG) is rejected as an instrument for this subsystem because reducing (NG) will have a smaller effect on time in the elevator than reducing the storage tariff. The storage tariff is selected as an instrument (SC*). SC* is a simple, annual choice. Reducing SC* will be a desincentive to keeping grain in an elevator and hence, will cause a reduction in TM1T (see 4.6). The relative movements of HT1* and SC* are vital in 4.6. HT1*/SC* was held virtually constant at 135 between 1950 and 1968 yet rapidly increased to 360 by 1975-76.[1] During the 1950's, SC* was relatively high, with the effect of encouraging construction of storage space and inhibiting elevator throughput. Since 1968, SC* has remained constant while $HT1^*$ has increased from 4½ cents per bushel to 12 cents per bushel in an effort to encourage elevator consolidation and higher throughput per elevator unit.

The selection of the investment tax credit variable as an instrument ($TC^*$) reflects the current tax laws that provide a 10 percent tax credit on new investments in storage. $TC^*$ is controllable by tax regulation and although the response may be slow to $TC^*$, a similar investment incentive (accelerated depreciation) was used effectively in the 1950's to encourage construction of elevator storage capacity. $TC^*$ is rather blunt and may encourage investment in both storage and handling capability although this study assumes $TC^*$ only affects handling capability.

---

[1] Canada Grains Council (1973 b), op. cit., p. 137, exhibit 17, and author's calculations.

## Side Effects

The Approach --In order to illustrate the many imprecise and unmeasurable consequences of using an instrument, a table of side effects was developed (Table 4.2). The fifteen criteria in the left column of Table 4.2 were arbitrarily selected by the author from literature on the System and public debate at the Hall Commission hearings. Competition and energy consumption, for example, are citizen concerns at the hearings. Side effects are ordered according to increased difficulty in measurement. Therefore, the first effect, investment, is easier to measure than safety which is, in turn, easier to measure than the effects of an instrument on livestock production in the Prairies.

Column headings indicate the more desirable direction of instrument movement (increase or decrease) and the targets that instruments are intended to affect in this subsystem. For example, increasing the cleaning tariff is intended to affect cost and time. The side effects of instrument and target movements according to the headings are evaluated as:

i) positive (+)
ii) negative (-)
iii) neutral (0)

For example, an increase in the cleaning tariff will increase (+) cleaning equipment investment in elevators, decrease (-) investment by others at port terminals. Yet increasing the cleaning tariff will have no effect (0) on farmers' income stability from year to year.

Some side effects will not occur immediately and are in fact lagged, or secondary and tertiary effects. For example, increasing the cleaning tariff will increase investment relatively soon in this

Table 4.2: Side effects of instruments considered for country elevator subsystem (#1).

| Instrument |  | Increase Cleaning Tariff | Decrease Quota Variation | Decrease Miles of "B" Line | Increase Initial Price |
|---|---|---|---|---|---|
| Intended Target |  | Cost<br>Time | Cost<br>Time | Cost<br>Time | Cost<br>Time |
| Investment - this system |  | + | 0 | + | 0 |
| Investment - by others |  | - | 0 | + | + |
| Rural Development |  | + | ± | - | + |
| Competition |  | + | + | - | + |
| Income Stability |  | 0 | - | - | 0 |
| Income Distribution |  | - | - | - | 0 |
| Spatial Equity |  | - | 0 | - | 0 |
| Grain Quality |  | + | + | 0 | 0 |
| Range and Quality of Services |  | + | 0 | - | 0 |
| Safety |  | + | 0 | - | 0 |
| Air Quality & Energy Consumption |  | + | 0 | 0 | 0 |
| Labor Productivity |  | + | + | + | + |
| Freedom to Allocate Resources |  | + | - | + | + |
| Grain Handling Coordination |  | + | ‡ | + | + |
| Livestock Production |  | + | 0 | + | - |
| Totals | + | 11 | 6 | 6 | 6 |
|  | - | 3 | 2 | 7 | 1 |
|  | net | +8 | +4 | -1 | +5 |

Table 4.2: (Continued)

| Instrument | | Decrease Storage Tariff | Increase Handling Tariff | Introduce Delivery Incentives | Increase Tax Incentives |
|---|---|---|---|---|---|
| Intended Target | | Time | Time Profits & Price | Price Profits | Investment |
| Investment - this system | | - | + | + | ++ |
| Investment - by others | | + | + | + | 0 |
| Rural Development | | + | - | ± | + |
| Competition | | + | + | + | + |
| Income Stability | | - | 0 | 0 | 0 |
| Income Distribution | | 0 | 0 | 0 | 0 |
| Spatial Equity | | 0 | | + | 0 |
| Grain Quality | | + | + | 0 | + |
| Range and Quality of Services | | 0 | + | + | + |
| Safety | | 0 | 0 | 0 | + |
| Air Quality and Energy Consumption | | 0 | 0 | 0 | + |
| Labor Productivity | | 0 | + | + | + |
| Freedom to Allocate Resources | | - | + | + | + |
| Grain Handling Coordination | | + | + | + | + |
| Livestock Production | | - | + | - | + |
| Totals | + | 5 | 10 | 9 | 12 |
| | - | 4 | 1 | 2 | 0 |
| | Net | +1 | +9 | +7 | +12 |

subsystem yet contribute to better air quality only after the investment is made. Any double signs indicate an exceptionally strong effect.

Side Effect Analysis -- Table 4.2 shows the author's assessments of instrument side effects. All instruments but rail abandonment show a net positive set of side effects. The investment tax credit has the most positive side effects at 12 with the cleaning tariff, handling tariff and delivery incentives close behind at 7 and 9. Rail abandonment has the most negative effects (7) with a net negative effect of minus one. On the basis of this author's judgement of side effects, rail abandonment should be the last instrument chosen for steering.

## Summary

Nine statements were introduced to explain the factors affecting the cost, price, and time targets and the investment condition. Intermediate or incidental variables necessary to explain the subsystem include dockage, producer marketings, elevator capacity, and seasonality of producer marketings. Seven instruments were selected. While judged most effective in reducing costs, rail abandonment had the most negative side effects. Tax incentives were judged the most effective instrument for influencing investment

The ratio of handling to storage tariff, if increased, reduces throughput time with few negative side effects. The Wheat Board setting of the initial price was judged most effective in affecting throughput and hence reducing costs and time.

The policy analysis opted for higher handling tariffs despite the possible negative effect on the producer because increased money in the hands of elevator firms would permit the payment of delivery incentives and facilitate compensation to farmers for elevator closure or branchline abandonment. This alternative will be developed further in Chapters VI and IX. The inland terminal subsystem is assessed next.

# CHAPTER V

# INLAND TERMINALS

## Introduction

Inland terminals differ from country elevators in that they:

1. have larger storage capacity (usually over 500,000 bushels),
2. plan on a higher ratio of handling to storage capacity (three to ten times),
3. can clean and dry grain,
4. can ship grain officially graded for export standards,
5. can load unit trains of forty cards or more.

Inland terminal subsystem #2 includes those firms and facilities that meet the above criteria. Like elevators, they receive, weigh, grade, purchase, store, and load grain onto rail cars or trucks. Table 5.1 gives the size, throughput, and ownership of the eight inland terminals operating in 1976. Note that the five Canadian Government elevators are only warehouses that receive grain purchased by any firm or the Canadian Wheat Board. By comparison, the owners of the Cargill and Weyburn facilities buy grain themselves.

Kulshreshtha[1] provides an excellent overview outlining inland terminals from a point of view of (1) commercial feasibility, (2) cost to the user, and (3) cost to the system as a result of introducing inland terminals. This model will draw heavily on Kulshreshtha's

---

[1] Surenda N. Kulshreshtha, An Examination of the Inland Terminal Approach in Rationalizing the Prairie Grain Handling and Transportation System, No. 266 (Saskatoon, Saskatchewan: University of Saskatchewan Transportation Center, April 1975). (Hereinafter referred to as 1975(b).).

Table 5.1: Number, location, and capacity of inland terminals in 1976, by owner

| Evaluative Criteria | Owner | | |
|---|---|---|---|
| | Cargill Grain Company | Weyburn Terminal Company | Canadian Grain Commission |
| Number of Terminals | 2 | 1 | 5 |
| Locations | Elm Creek<br>Rosetown | Weyburn | Moose Jaw,<br>Saskatoon,<br>Calgary, Edmonton<br>Lethbridge |
| Storage Capacity (millions of bushels) | 0.5 | 1.0 | 1.25 to 5.5 |
| Maximum Rated Throughput per Terminal (millions of bushels) | 10.0 | 20.0 | 10.4* |

* Rated throughput capacity unavailable. Figure is actual maximum at the Saskatoon terminal in 1973-74.

Source: Cargill, op. cit., pp. 18;
Kulshreshtha, op. cit., p. 3;
Canada Grain Commission, Annual Report, Ottawa: Queens's Printer 1974, p. 17.

works and address itself to aspects of the cost to the user and cost to the System. For added insight, see proposals by Bryden,[1] Cargill Grain Company,[2] and Peace Agra Cooperative[3]. Note that the term "high throughput elevator" is sometimes applied by the line grain companies to very large facilities which for this study will be called inland terminals. In the author's view, "high throughput elevators" are those having a storage capacity between 150,000 and 250,000 bushels and handling 0.5 to 3 million bushels. Such elevators are the type of investment reflected by model 4.9 in subsystem one.

Performance measures or targets selected for subsystem #2 include:

1. Realized cost to the terminal operator (RC2T).
2. Time reduction to the whole system as a result of terminal operations (TM2T).
3. Price to the farmer (PF2T).

Investment in new inland terminal facilities (IN2S) is introduced as a condition of vital importance.

## Structural Relationships

The logic of the five models is described in Figure 5.1. Since so little investment has taken place in inland terminals, the author acknowledges that model 5.5 (describing investment) could not be quantified at this time.

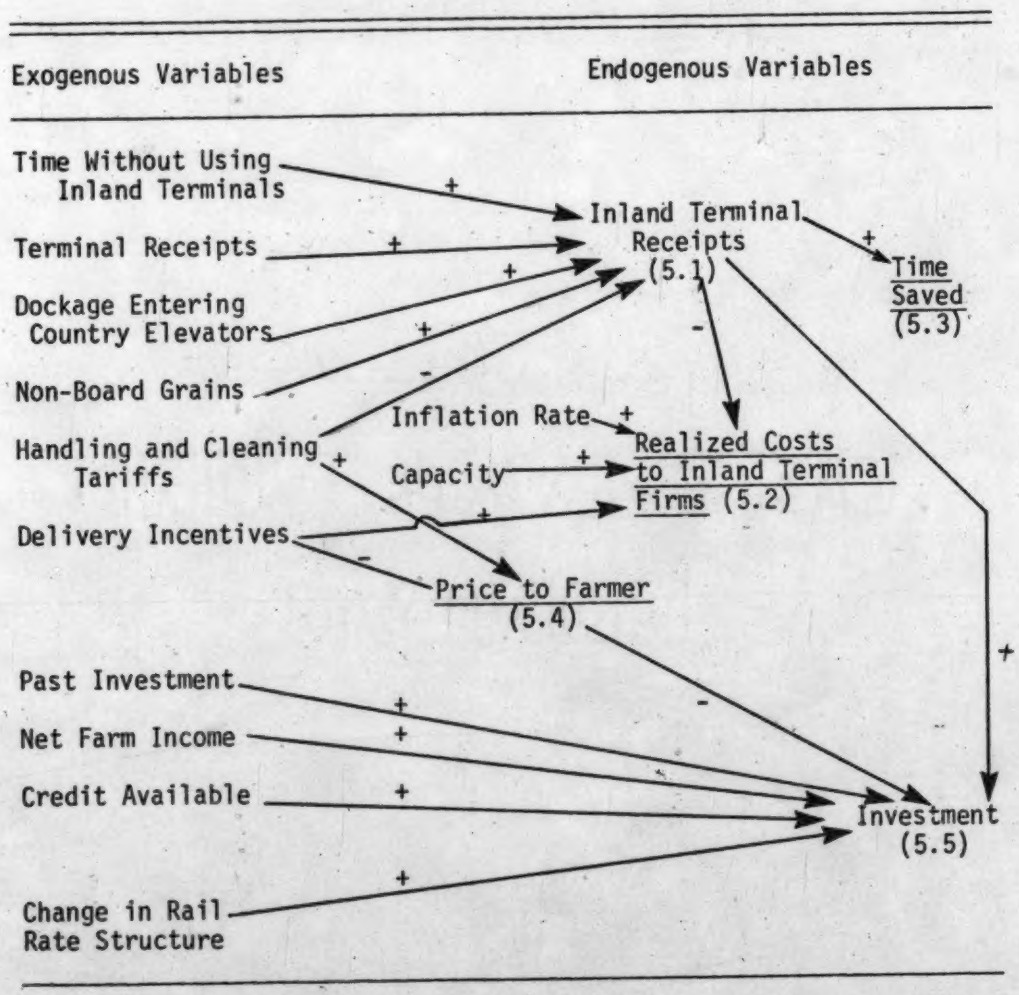
---

[1] Rod Bryden, "Country Terminals", Ottawa, Ontario, 1975. (Mimeographed.)

[2] Cargill Grain Company, op. cit., pp. 17-61

[3] Peace Agra Cooperative Ltd., "A New Concept for Crop Handling Stations and Transportation," Fairview, Alberta, 1975, pp. 17-31. (Mimeographed.)

Figure 5.1: Logical relationships among variables in the inland terminal subsystem (#2).


Exogenous Variables
Endogenous Variables
Time Without Using Inland Terminals
Terminal Receipts
Dockage Entering Country Elevators
Non-Board Grains
Handling and Cleaning Tariffs
Delivery Incentives
Inflation Rate
Capacity
Inland Terminal Receipts (5.1)
Time Saved (5.3)
Realized Costs to Inland Terminal Firms (5.2)
Price to Farmer (5.4)
Past Investment
Net Farm Income
Credit Available
Change in Rail Rate Structure
Investment (5.5)
+
-

Inland Terminal Receipts

$$IT2 = f\,(\underset{+}{TR4},\ \underset{+}{DE1},\ \underset{-}{HT2},\ \underset{+}{DI2},\ \underset{+}{NB},\ \underset{+}{TT6T}) \qquad 5.1$$

where:

IT2 = Inland Terminal Receipts per year, in millions of bushels,

TR4 = Terminal Receipts, in millions of bushels,

DE1 = Dockage entering country elevators during a year, in millions of pounds,

HT2 = Handling tariff plus cleaning and drying tariff at inland terminals, in cents per bushel,

DI2 = Delivery incentive for delivering to inland terminals, in thousands of dollars per year,

NB = Non-board grain shipments from primary elevators and interior terminals as a percent of total grain shipments, per year,

TT6T = Time, in days, for Wheat Board-directed grain handling functions (in country elevator, railway, and port subsystems).

This model is a basic demand model derived on a yearly time series basis.[1] Demand for inland terminals is of two kinds -- normal demand (ND) and surge demand (SD) where:

$$ND = f\,(\underset{+}{TR4},\ \underset{+}{DE1},\ \underset{-}{HT2},\ \underset{+}{NB}) \qquad 5.1a$$

$$SD = f\,(\underset{+}{TR4},\ \underset{+}{DE1},\ \underset{+}{TT6T},\ \underset{+}{DI2}) \qquad 5.1b$$

Model 5.1a says the use of an inland terminal will vary as the volumes required at the port because overflow capacity beyond primary elevators will be needed. Since alternate cleaning and drying facilities exist only portside, increases from year to year in the dockage combined with grain (DE1) will cause firms and the Wheat Board to direct more grain through inland facilities. (HT2) is the price of the service -- as it is increased, facility use would be expected to decline, ceterus paribus. Lastly, normal demand for terminal services will increase as the proportion of shipments in non-Board grains (NB) increases. Demand for inland terminal services grow with non-Board volumes because owners of grain prefer the more shipable position at inland terminals rather than country points in order to take advantage of premiums between cash and future markets at Vancouver.

---

[1] If the time period were reduced from an annual to a monthly model, the accuracy of a regression analysis would increase. Since the extent of this model does not cover intra-year analysis and since other aspects like realized cost are an annual result, 5.1 is left on an annual basis.

Surge demand (SD) is that use of inland terminals to speed up the system so as to meet month-to-month critical shipping situations as have developed in recent years. (SD) develops when shipping volumes (TR4) are high, as in 1971-72 and 1972-73. After an experience in 1971,[1] the Canadian Wheat Board organized annual "surge volume" programs to commercially truck a portion of export grain to Canadian Government interior elevators. These programs[2] showed that commercial trucking, inland terminals and unit trains can be organized to offset delays in System throughput due to tough or damp grain, dockage levels in grains and labor-management disputes. Tough or damp grain are reflected by DE1 in 5.1b. Slowdowns from labor-management disputes and other considerations developed in other subsystems are reflected by the average days that the regular farm-elevator-train-port terminal system operates (TT6T). As TT6T increases, more grain would be diverted either directly from the farm or from satellite elevators to inland terminals; hence, (TT6T) has a positive sign. Finally, to cause the grain to move through inland terminals, the Wheat Board paid for the trucking as an incentive. This and other[1] incentives are reflected in the model by (DI2). Measurement of (DI2) would be difficult except for Canadian Wheat Board incentive payments as reported in Board annual statements.

---

[1] Canadian Wheat Board, "Report on Test of Commercial Truck Movement of Barley from Country Elevators to Canadian Government Interior Terminals," Winnipeg, Manitoba, 1972. (Mimeographed.)

[2] Canadian Wheat Board, op. cit. (1974-75), p. 43.

Normal demand relationships (5.1a) and factors causing surge demand (5.1b) come together as a total demand function (5.1) for inland terminal receipts. The effect of any change in storage is not shown because the prime function of inland terminals should be fast throughput which requires low stock levels.

Realized Costs

$$RC2T = f(\underset{-}{IT2}, \underset{+}{IC2}, \underset{+}{IR}) + DI2/IT2 \qquad 5.2$$

where:

RC2T = Realized costs per bushel to inland terminal operators per year,

IC2 = Inland terminal storage capacity, in thousands of bushels,

IR = Inflation rate as measured by G.N.P. deflator.

Costs are not available on a terminal by terminal basis over time.[1] The Inland Terminal Study done for the Grains Group by M.R. Thompson[2] estimated total costs to be 2/3 fixed and 1/3 variable, with inflation affecting only variable costs. Kulshreshtha[3] also found total costs to be largely fixed. Hence average costs per bushel (RC2T) are sensitive to volume changes (IT2).

---

[1] In 1975-76, Alberta Rapeseed Ltd., Bunge, and Continental also frequently offered pricing premiums on rapeseed for delivery to Canadian Government elevators.

As described in the supporting description of model 2.5, the Canada Grains Council study of elevators found storage capacity and receipts to predict costs accurately over a diverse set of facilities. Thus it seems reasonable to use storage capacity (IC2) as a measure reflecting fixed costs and annual receipts (IT2) as a reflection of variable costs. Costs would vary inversely as (IT2) and directly as (IC2). Costs would increase over time in relation to inflation (IR). Both Thompson and Kulshreshtha indicate the effect (or coefficient) of inflation would be lower in an inland terminal cost function than for country elevators (model 4.5) since labor and administration play a smaller part in inland terminals. The Gross National Product Deflator is chosen as the measure of inflation because of its preferable performance in reflecting local government costs as (illustrated in a previous study in which this author assisted).[1]

---

[1] Reports by the Canadian Grain Commission for Canadian Government elevators provide only totals for all five elevators.

[2] M.R. Thompson, "Inland Terminal Study," quoted in Canada Grains Council (1973).

[3] Kulshreshtha, op. cit., p. 5.

Total delivery incentives offered during the course of the year by the subsystem -- whether to attract surge demand or to bolster throughput during periods of low handlings -- incur cost to this subsystem (DI2). The average incentive per bushel is calculated by dividing (DI2) by bushels received (IT2). The resulting average incentive cost (DI2/IT2) is then added to RCIT, to complete 5.2.

Time

$$TM2 = z\ (\underset{+}{IT2})/(TR4) \tag{5.3}$$

where:

TM2 = Days removed from the normal time required to forward grain using country elevators,

z = Number of days removed from rail car cycle when using inland terminals compared to country elevators.

This definitional equation calculates the time savings contributed to the whole system by this subsystem. According to the C.P.R., the average car cycle for a grain car from primary elevators is eighteen days for a round trip to Vancouver.[2] Pound[3] observed that unit train operations out of Lethbridge obtained a seven day turn around. The difference between normal operations and this experiment is a saving of eleven days. For this model, such a saving was set at "z" days saved. Thus:

---

[1] Allan A. Warrack, "An Analysis of Inflation Impact on Local Governments in Canada" (unpublished study for Prices and Incomes Commission, 1970), pp. 35-36.

[2] C.P. Rail, "Submission to the Standing Committee on Transportation," Montreal, Quebec, October 1974, p. 3. (Mimeographed.)

[3] H.D. Pound, "The Role of the Canadian Grain Commission in Modernization." Address to Semi-Annual Meeting of the Canada Grains Council, Edmonton, Alberta, October 28, 1974, p. 13.

("z" days saved) X (IT2) bushels moved through inland terminals = bushel-days saved 5.3a

Dividing both sides of 5.3a by total bushels moved to terminals (TR4) averages the time saving to a per bushel basis (TM2) which is measured in days. The factor "z" could itself be a behavioural equation but the limits of this study did not permit study of its specification.[1]

Price to the Farmer

PF2T = HT2 - (DI2)/(IT2) 5.4

where:

PF2T = Price to the farmer, per bushel, for services provided by subsystem 2.

Price to the farmer is an accounting or balancing equation. For a given price to farmers (PF2), handling tariffs (HT2) can be raised provided average delivery incentives (DI2)/(IT2) are also raised to offset added charges. Such use of incentives will be developed in the policy implications section. Added trucking costs from terminal use are omitted from 5.4 but will be reflected in trucking subsystem #8 (statement 9.5).

---

[1] For a listing of institutional actions reducing the car cycle, see C.P. Rail, "Busmission to the Commission on the Costs of Transporting Grain By Rail," Vol. III Winnipeg, Manitoba, April 1976, pp. CP-5-1 to CP-5-11. (Mimeographed.)

Investment

$$IN2S = f\,(\underset{+}{IT2},\ \underset{+}{IN21},\ \underset{-}{PF2/PF1},\ \underset{+}{NF},\ \underset{+}{CR3},\ \underset{+}{CR2}) \qquad 5.5$$

where:

IN2S = Investment in inland terminals per year, in millions of dollars by all firms and agencies,

NF = Net Farm Income on the Prairies from crop production, in millions of dollars,

CR3 = Change in the rate structure paid to railways for moving grain, measured as a dummy variable,

CR2 = Credit available for investment in inland terminals, in millions of dollars.

With so few recent investments in inland terminals, this model is purely speculative and not capable of being estimated at this time. Statement 5.5 makes no inferences[1] about where terminals should be located.

---

[1] A cursory review of commercial feasibility studies for inland terminals suggests to the author that practical inland terminals for most Prairie locations would have storage capacities between 250,000 bushels and 600,000 bushels and throughputs of three to ten million bushels with 25 percent to 40 percent of the area market.

Sites for inland terminals should:

a. be a present or apparent future trading center served by a strategic road network,

b. be served by a rail line forming part of the basic rail network and have frequent service,

c. be an area where large stable volumes of relatively few varieties and grades of grain are available within 25 to 30 miles,

d. be an area where the competition practises and existing elevator capacities permit over 25 percent of the market share.

Source: Cargill, op. cit., p. 25; Bryden, op. cit., p. 1.

Elements of 5.5 are either variable or institutional. The five variables in the model and the reasons for their selection are:

1. (IT2) -- Investment will increase as the volumes that are going through existing facilities (IT2) increase. (IT2) will demonstrate to investors that the inland terminal concept is viable.

2. (IN21) -- Investment in a terminal will increase as past investment (IN21) increases due to demonstrated producer acceptance of the concept. Cargill's five year investment strategy reflects this relationship.[1]

3. (NF) -- Investment by producer-initiated local companies like Weyburn will come forth in substantially larger amounts when net farm incomes are higher. The study by Denton, et al.,[2] showed new investments of $80 in structures would be forthcoming from the Canadian farm economy for every $1,000 increase in net farm income.

4. (PF2)/(PF1) -- As the price to the farmer for using the inland terminal (PF2) decreases relative to the price for using the country elevator (PF1), the farmer and other firms will invest more in this inland terminal concept. Cargill[3] verifies this hypothesis.

---

[1] Cargill, op. cit., p. 23.

[2] Frank T. Denton, et al. Prices, Incomes and Capital Formation in Canadian Agriculture. (Ottawa, Ontario: Food Prices Review Board, March 1975), p. v.

[3] Cargill, op. cit., pp. 20 and 23.

5. (CR2) -- Investment will increase as the total credit available for debt capital investment in terminals increases. Denton, et al.,[1] found credit extended to be more significant than interest rates as a predictor of investment by farmers. Interest rates were therefore rejected as a variable by the author. The Possibility of capital injections from outside the system is incorporated by this variable. Potential external sources include government and foreign parent companies like Cargill, Bunge, or Continental. Measuring the dollars of available debt capital would be very difficut.

Rail rate structures (CR3) are unmeasurable except by a dummy variable taking the value "0" for the years when no change is instituted and "1" for the years the policy changes are in effect. The nature and effect of this variable will be left to the next section on policy implications.

## Policy Implications

### Instrument Selection

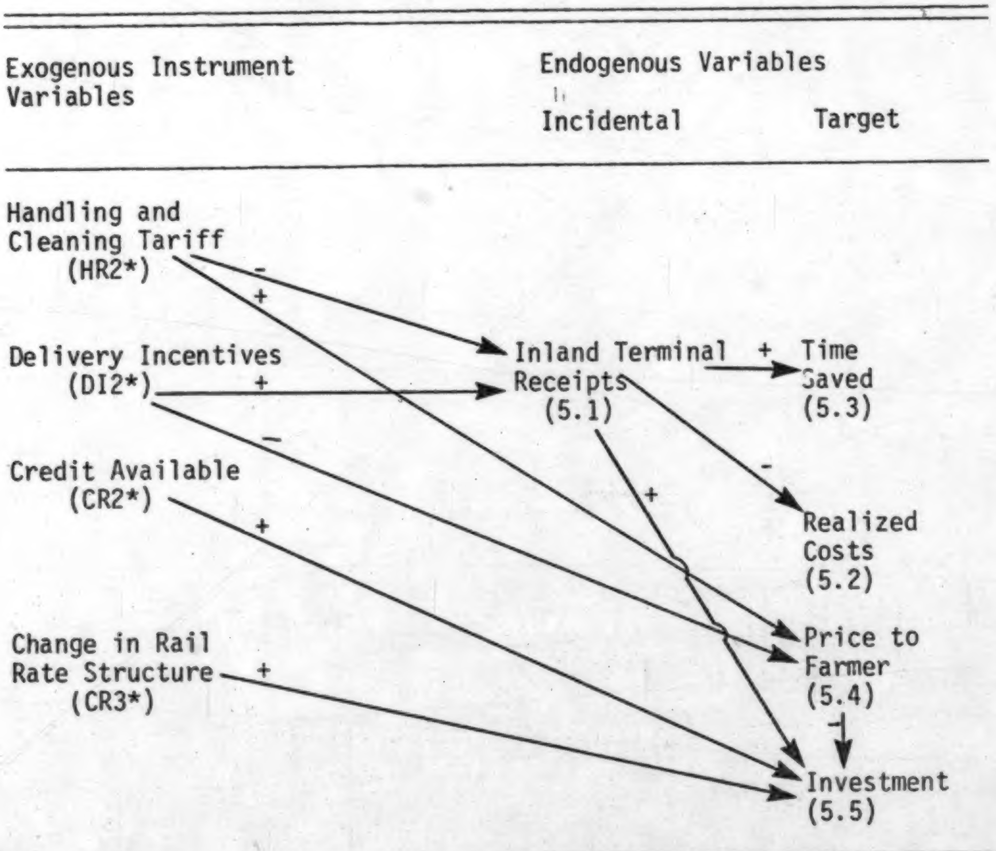
Four of the nine exogenous variables are selected and evaluated as instruments affecting the three targets plus the constrained side effect, investment. Figure 5.2 below shows the linkages between instruments and one or more targets.

Table 5.2 identifies the author's view of positive and negative effects on measurable factors of concern to public policy. "Miles of B Rail Line" and "Number of Elevators"

---

[1] Denton, op. cit., pp. 20 and 24.

Figure 5.2: Instrument-target linkages selected for inland terminal subsystem (#2).


Exogenous Instrument Variables
Endogenous Variables
Incidental
Target
Handling and Cleaning Tariff (HR2*)
Delivery Incentives (DI2*)
Credit Available (CR2*)
Change in Rail Rate Structure (CR3*)
Inland Terminal Receipts (5.1)
Time Saved (5.3)
Realized Costs (5.2)
Price to Farmer (5.4)
Investment (5.5)
-
+
+
-
+
+
+
-
+
-

are added as evaluative criteria reflecting the added political and economic pressure to abandon the existing elevators and light density track when, and if, policy instruments are changed to encourage inland terminals. The opposing entries in the row for "Investment by Others" indicates investment by the trucking subsystem will increase while elevator investment will decrease when policies encourage inland terminals.

Table 5.2: Side effects of instruments selected for inland terminal subsystem (#2).

| Instrument: | Decreased Handling & Cleaning Tariff | Increase Delivery Incentives | Change in Rail Rate Structure | Increase Credit Available |
|---|---|---|---|---|
| Intended Target | Time, Cost, Price | Time, Cost, Price | Invest- ment | Invest- ment |
| Side Effect: | | | | |
| Investment - This System | + | + | + | + |
| Investment - By Others | +<br>- | +<br>- | +<br>- | 0 |
| Rural Development | + | + | +<br>- | +<br>- |
| Competition | + | ++ | - | + |
| Income Stability | + | + | - | 0 |
| Income Distribution | - | + | - | 0 |
| Spatial Equity | 0 | + | - | 0 |
| Grain Quality | + | + | 0 | 0 |
| Range and Quality of Services | + | + | - | 0 |
| Safety | 0 | - | + | 0 |
| Air Quality & Energy Conservation | - | - | + | 0 |
| Labor Productivity | 0 | + | ++ | 0 |
| Freedom to Allocate Resources | - | + | +- | - |
| Grain Handling Coordination | + | ++ | + | 0 |
| Livestock Production | - | + | + | 0 |
| Miles of "B" Rail Line | 0 | - | - | - |
| Number of Elevators | + | - | - | - |
| Totals positive | 10 | 15 | 10 | 3 |
| negative | 4 | 5 | 10 | 4 |
| net | +6 | +10 | 0 | -1 |

Handling and Cleaning Tariffs -- (HT2) is selected as an instrument (HT2*) because it is currently used as an instrument of the Canadian Grain Commission which sets its upper level. Furthermore, the price of inland terminal services (HT2*) is somewhat influential in attracting receipts (model 5.1). Receipts are, in the author's view, the largest factor in determining realized costs (5.2) and investment (5.5). Reductions in (HT2*) has a direct effect on reducing the price to farmers (5.4). (HT2*) is an administratively simple choice which is made annually. Its one weakness is that the three owners of inland terminals need not necessarily charge the maximum tariff so that a decrease or maintenance of no change in (HT2*) would only affect those charging the maximum.

After evaluation, the author has rejected the Cargill proposal[1] to set a single all inclusive maximum tariff. Cargill suggests this in return for a "total service package" including receiving and elevation at terminals in addition to elevation and cleaning now charged at the country elevator and inland terminal. While this structural change would increase competition at the interface of the producer and grain handler, it would serve as a barrier to entry for new firms wanting to invest in a country elevator or inland terminal. Under a single maximum tariff, new entrants would also have to offer port terminal services, which increases the size and complexity of an investor's threshhold investment. In rejecting one inclusive tariff, the author points out that owners of the grain in an elevator or inland terminal currently have the opportunity to deliver to a port terminal under the umbrella of a separate port handling tariff subject to Canadian Grain Commission maximum.

---

[1] Cargill, op. cit., pp. 44-49

Side effects from decreasing handling and cleaning tariffs are, on balance, positive, as shown in Figure 5.2. Negative effects are anticipated for elevator investors, small income farmers, the environment and energy conservation, and freedom to allocate farm resources (see Figure 5.2).

Delivery Incentives -- (DI2) was selected as an instrument (DI2*) of the Canadian Wheat Board. The Board can use their trucking incentives to demonstrate to the industry the value of using trucking incentives to move a product into position in a manner which cuts overall time (5.3) between farmer and the ship. The author recognizes that the Board discontinued its trucking programs in 1975-76 because of cost 15.3 cents additional cost per bushel[1] in terms of the Price to Farmers (i.e., PF2 = 15.3) . The Board's logic fails to consider two items:

1. Any reductions in per bushel realized costs (model 5.2) (from added inland terminal receipts broght on by the incentives) were not given back to the Board and hence, the farmer. By the author's estimates, the Board should have negotiated a 2 cent

---

[1] Canadian Wheat Board, op. cit. (1974-75). pp. 44-45.

reduction in the tariff[1] for providing two-thirds of the 1973-74 Canadian Government interior terminal handlings. Since volume discounting of tariff levels is against the Canada Grain Act, the Board should consider asking for a lump-sum transfer or negotiate the purchase of some or all terminals in order to internalize the effects on realized costs.

2. Board reporting did not report Time Saved (model 5.3), which reflects on the price to the farmer through model 8.2 which will be developed later. The reduced storage and interest charges plus additional prices and sales volumes that may have been received as a result of the "p" days saved may well cover the remaining 13.3 cents additional cost. The actual gain should have been reported next to the additional costs.

In conclusion, the above example gives some indication of how the delivery incentive instrument (DI2*) works and how, to date, the feedback signals to compensate for incentive expenditures are relatively underdeveloped in real life. In the author's view, delivery incentives as used in Wheat Board experiments were effective as a stimulus to reduce realized costs. Side effects shown in column 2 of Table 5.2 are very positive, on balance, especially in terms of added competition and better grain handling coordination. Increasing delivery incentives, however, cuts back on elevator investment, road safety and energy conservation because of greater use of trucks rather than rail. Because delivery incentives introduce greater truck movements, the demise of local elevators and the abandonment of more branchlines are anticipated and judged as negative effects.

---

[1] Between 1971 and 1974, the Canadian Grain Commission net revenue (revenue less expenditures) on Canadian Government elevators increased from $228,849 to $772,584 largely because the Wheat Board trucking programs increased handlings from 6,188,000 bushels to 31,470,000 bushels. This works out to approximately 2 cents marginal net revenue per bushel.

Change in Rail Rate Structure -- Basically the change (CR3) would lower the ton-mile rate in proportion to car spotting and rail efficiencies that can best be developed at inland terminals. Cargill[1] and the U.G.G.[2] argue such a rate change would effectively encourage investment in consolidated, large handling facilities providing multiple car loading. A change in the railway rate structure will be developed and assessed more fully in subsystem #.3. In selecting CR3 as an instrument (CR3*), the author judges it to be effective although administratively very difficult because (CR3*) requires an Act of Parliament (to change the statutory grain rate).

Table 6.2 on side effects indicates many negative side effects of CR3* which are balanced by many positive effects. Both positive and negative effects are identified for three criteria: investment by others, rural development, and freedom to allocate resources. These arise because those near terminals will substantially benefit while those farther away will lose. A comparison of the direction of side effects between (CR3*) and (DI2*) indicates they balance or net themselves to zero. For example, reductions in the income distribution to smaller farmers is positively offset by delivery incentives to compensate them. This instrument is therefore rejected as a means to encourage investment in inland terminals.

---

[1] Cargill, op. cit., p. 59.

[2] United Grain Growers, op. cit., pp. D-1 to D-4.

Credit Available -- Credit Available (CA*) is selected as an instrument (CA2*) because the substantial front-end investment for an inland terminal makes it very sensitive to cash flow and cost of capital. That is, (CA2*) would effectively spur investment. Credit could be made more available through provincial borrowing agencies like the Alberta Agricultural Development Corporation or Federal agencies like the Department of Regional Expansion. Depending on their assessment of economic, social, or political implications, either or both government levels could be involved. In some provinces the possible competition between government levels may cause a better arrangement for investors.

Side effects of increasing available credit are judged to be more neutral than the effects of a rail rate restructuring. The negative effects on farms at a distance from terminals will still be felt in terms of rural development, allocative freedom, and pressure to abandon rail lines and elevators.

Instruments Rejected -- During local Hall Commission hearings in 1975-76, two additional instruments were debated. While each instrument is administratively simple, it is extremely negative and provides no incentives for innovations to be competitively developed to reduce the price to the farmer for grain handling services. Following is a brief description of the instruments and the reasons for rejecting them as instruments for affecting investment and receipts at inland terminals:

1. Instrument: Stiff licensing requirement (to show public need) before inland terminals can be built.

   Effect: Discourages construction of another Weyburn-type terminal and possible overbuilding of capacity.

   Rejection Rationale:

   a. This is contrary to principles of free enterprise and discourages needed innovation.
   b. Unless simultaneously applied to the elevator subsystem, it would be discriminatory.
   c. Unless stiff licensing conditions could be dealt with through high fees, the losers (like municipal roads) from investment would be no farther ahead and farm benefactors of a more effective system (who are also taxpayers) would be worse off.
   d. Since licensing regulations are more easily met by larger, more powerful firms, this licensing barrier to entry discriminates against the smaller entrepreneur.

2. Instrument: The Saskatchewan government application of lower load limits on municipal roads to discourage long haul trucking by semitrailer trucks.

   Effect:

   a. Discourages long haul trucking, especially by semitrailer trucks.

b. Indirectly discourages off-track, satellite elevators.

Rejection Rationale:

a. It reduces trucking options for farmers and likely increases their cost whether inland terminals are built or not. Potential societal costs to the municipality are transferred into certain private costs to farmers.

b. Program is highly discriminatory since cattle and industrial goods are exempt. This will encourage the movement of resources out of grain production in the long run.

c. Program is based on erroneous engineering assumptions -- more frequent and poorly loaded small farm trucks are harder on roads than less frequent, semitrailer trucks.[1] Larger and fewer commercial trucks can also be more easily regulated to maintain proper axle loading.

Outward Linkages

This subsystem has many interfaces or connections with other subsystems in the model. Some of these linkages are vital enough to include one of the five endogenous variables as dependent, explanatory variables in other subsystems. The effects on other subsystems include:

---

[1] Alberta Transportation, "Preliminary Summary of Road Costs Due to Possible Rail Line Abandonment," Edmonton, Alberta, October, 1975, p. 8.

1. Increased inland terminal receipts and investment will reduce realized costs to the railways.

2. Increased investment will reduce elevator numbers and, in turn, reduce total system storage capability trackside while spurring farm storage investment.

3. Investment and increased recognition of time savings (TM2T) will encourage additional vertical integration by firms from port terminal to farmer's gate.

4. Additional receipts or investment will increase value added in the provincial and municipal subsystem yet increase road costs.

5. By moving port functions to Prairie locations, the effect of labor unrest at port terminals and other subsystems should be reduced.

## Summary

This chapter focussed on five simple relationships yet identified some of the complex policies and extensive side effects or externalities associated with inland terminals. Handling tariff maximums (HT2*) and Wheat Board delivery incentives (DI2*) were assessed as instruments to reduce cost, increase time saved, and reduce the price to farmers. Increasing available credit to inland terminals (CR2*) and changing the rail rate structure to reflect car spot (CR3*) were selected and assessed as means to increase investment. The next chapter will continue the description of the major direct stakeholders in this presentation of the railway subsystem.

# CHAPTER VI

# RAILWAY SUBSYSTEM

## Introduction

This chapter will reflect the variables affecting that portion of Canadian railway facilities and operations which are (a) west of Thunder Bay and (b) involved in ground transportation. Rail subsystem functions include:

1. Distribution of empty cars to, and gathering of loaded cars from, primary elevators.
2. Movement of cars from local distribution yards to main classification yards in Winnipeg, Calgary and Edmonton.
3. Movement of cars from main classification yards to domestic and export positions.
4. Spotting loaded cars at terminal facilities and assembling of empty cars for movement back to primary elevators.[1]

These functions are carried out subject to Canadian Transport Commission regulations and the Wheat Board's block shipping system.

Indicators chosen as subsystem targets are:

1. Realized Cost to the railways and Federal Government for transporting grain (RC3T).

2. Time in the railway subsystem (TM3T).

Investment in railway facilities (IN3S) is introduced as an important condition.

---

[1] Canada Grains Council, (1973 b), op. cit., p. 4.

Because of the extent of this study, the complexity of the rail system cannot be reflected in much detail. The Western Producer's "What Should be Done with Railways?"[1] provides a laymen's guide to general transportation policy issues affecting grain. The State of the Industry[2] report identifies the effects on railway costs of the statutory grain rates, elevator consolidation, and other factors in the grain handling and transportation system. At the time of writing, the Commission on Transporting Grain by Rail, led by Carl Snavely, is nearing completion after one year of deliberation on the principles and 1974 levels of railway costing (including rahabilitation and upgrading). This study will draw on submissions to the Snavelly Commission by the provincial governments and railways prior to April 30, 1976.

At the time of writing, the Hall Commission on Grain Handling and Transportation has conducted local and provincial hearings in order to develop recommendations on:[3]

1. The abandonment, retention or upgrading of "B" category railway lines.

2. Aspects of the grain handling industry related to railways.

---

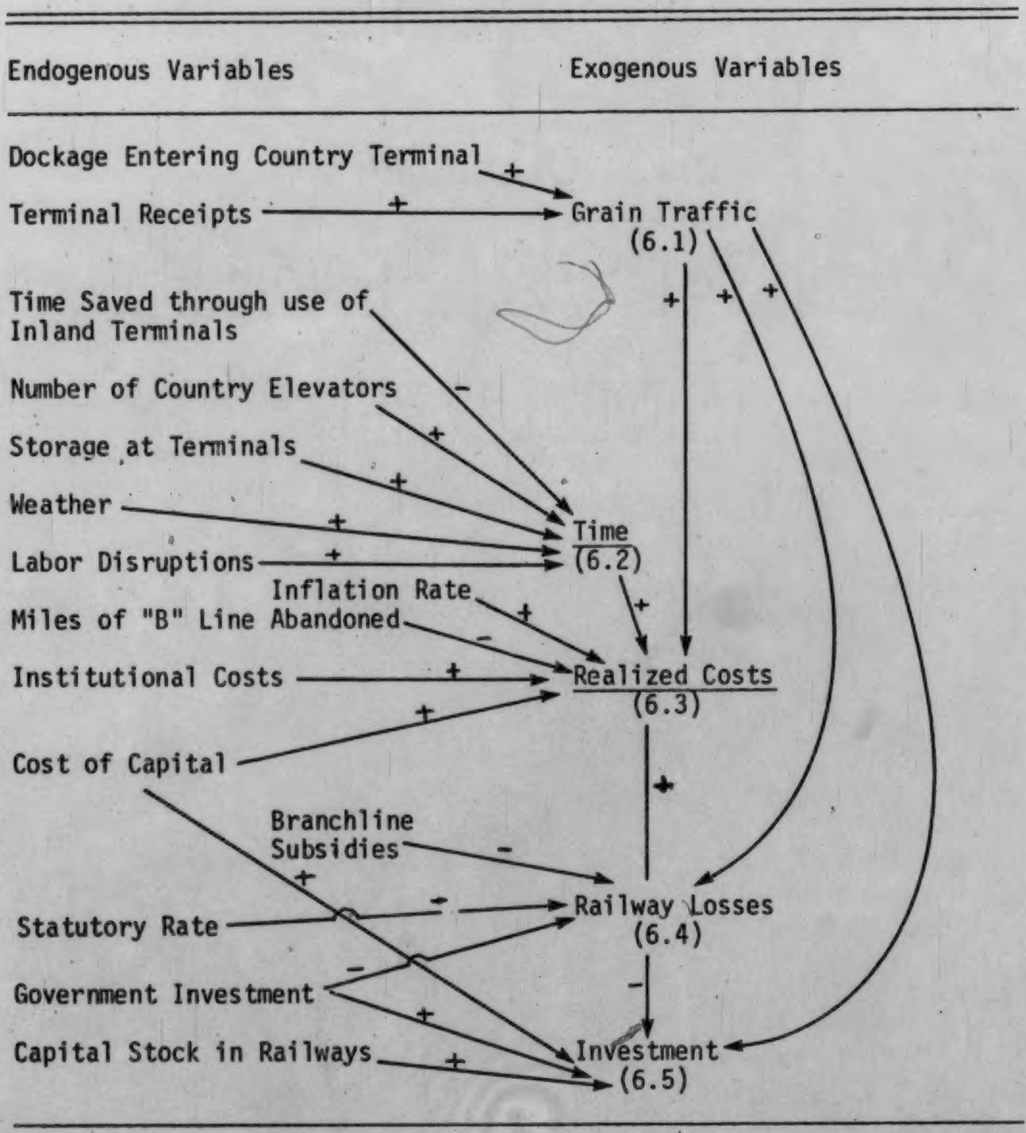
[1] "What Should be Done with the Railways?" A Special Section of the Western Producer, July 31, 1975.

[2] Canada Grains Council, (1973 b), op. cit., Chapters 4 - 10.

[3] Grain Handling and Transportation Commission, "Terms of Reference," Saskatoon, Saskatchewan, 1975. (Mimeographed.)

In building the model for this subsystem, the author will draw heavily from his experience in these hearings and from informal discussions with the Hall Commissioner and railway officials. Figure 6.1 graphically shows the variables affecting the five endogenous variables modelled. There is a high degree of interrelatedness between models which makes a presentation difficult but attempts to reflect the real world.

Figure 6.1: Logical relationships among variables endogenous and exogenous to railway subsystem (#3)


Endogenous Variables
Exogenous Variables
Dockage Entering Country Terminal
Terminal Receipts
Grain Traffic (6.1)
Time Saved through use of Inland Terminals
Number of Country Elevators
Storage at Terminals
Weather
Labor Disruptions
Time (6.2)
Inflation Rate
Miles of "B" Line Abandoned
Institutional Costs
Realized Costs (6.3)
Cost of Capital
Branchline Subsidies
Statutory Rate
Railway Losses (6.4)
Government Investment
Capital Stock in Railways
Investment (6.5)
+
−

### Structural Relations

Except for model 6.5 on investment and model 6.3 on time, the functional or logical relationships in this subsystem could not be estimated by regression techniques. Rather, the identified variables and the direction of their effect on other variables indicate the most vital technical or accounting adjustments one would make in future years to update the Snavelly Commission decisions. For example, statement 6.1 indicates that the levels of dockage and terminal receipts are the most vital output variables to adjust when updating Snavelly's calculations of total 1974 net ton-miles of grain traffic. It is hoped this approach identifies the key variables to be monitored by policymakers without bogging them down in the detail of railway and Canadian Transport Commission accounting.

Grain Traffic

$$GT3 = f\ (\underset{+}{DE1} + \underset{+}{TR4}) \qquad 6.1$$

where:

GT3 = Grain traffic, in millions of net ton-miles,

DE1 = Dockage entering country elevators during a year, in millions of pounds,

TR4 = Terminal receipts at Pacific Coast, Churchill, and Thunder Bay ports, in millions of bushels.

Net ton-miles is only one of many measures of output used to develop railway costs[1] yet appears to be one that incorporates distance and tonnage effects while netting out car weights.[2] In model 6.1 dockage and terminal receipts are shown separately to maintain the identity of dockage effects introduced in subsystem #1. Model 6.1 is an accounting equation where the coefficients, once estimated, would include distance (judged to change little from year to year) and a conversion factor to unify units of measure (converting pounds and bushels to tons). Thus, (distance x net tons moved) = (net ton-miles) results from 6.1.

---

[1] For an example listing of C.P. Rail output units, see C.P. Rail, "Submission to the Commission on the Costs of Transporting Grain by Rail," CP-1 presented in Winnipeg, Manitoba, April, 1976, p. CP-3-1. (Mimeographed.)

[2] Gross ton-miles or car-miles are comparable output units used by C.P. Rail.

Time

$$TM3T = f(\underset{+}{ST4}, \underset{+}{TW}, \underset{+}{LD}, \underset{+}{NE}) - (TM2) \qquad 6.2$$

where:

ST4 = Stocks in the port terminals, in millions of bushels,

TW = Total weather influence from August to June as measured by inches of precipitation times the areas of the Prairies and B.C. associated with grain handling,

LD = Labor disruptions as measured in percent of total working days that the grain handling and transportation system is affected by labor shutdowns in various sectors of the System,

NE = Number of elevator units

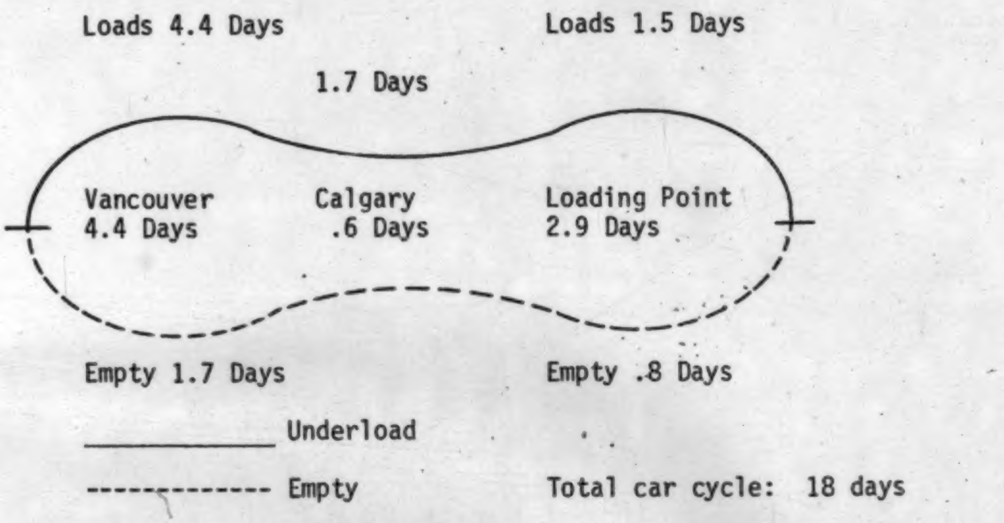
TM2 = Time saved in the car cycle as a result of utilization of inland terminals, measured in days per bushel.

The dependent variable of model 6.2 is further explained by Figure 6.2, which shows the car cycle to Vancouver. Days inside the circle are the waiting time at each location and the days around the perimeter are days in transit between loading at country elevator units, switching at Calgary, and switching and unloading at Vancouver. Reduction in car days is vital to the railways as one day removed from the cycle reduces car requirements by over 750 cars in the grain fleet.[1]

---

[1] C.P. Rail, "Submission to the Standing Committee on Transportation," Montreal, Quebec, October, 1974, p. 2.

Figure 6.2: C.P. Rail Grain Car Cycle to Vancouver, 1973


Loads 4.4 Days
Loads 1.5 Days
1.7 Days
Vancouver
4.4 Days
Calgary
.6 Days
Loading Point
2.9 Days
Empty 1.7 Days
Empty .8 Days
Underload
Empty
Total car cycle: 18 days

Source: C.P. Rail, (1974), op. cit., p. 2.

The car cycle in Figure 6.2 shows that 8.8 days (or approximately 50 percent) of the car time is spent loaded and in line-ups between Calgary and the unloading terminals in Vancouver. Horner[1] suggested this indicates that hold-ups and inefficiencies in transportation are west of Calgary, not on Prairie branchlines. Statement 6.2 reflects a similar bias. The level of storage stocks (ST4) is introduced as a measure of port congestion: as stocks near the maximum capacity level, unloading will slow down and car cycle will increase. Total weather (TW) is a crude measure of the often-mentioned effect of weather[2] in slowing trains on snow-bound or soft branchlines and in mountain passes. Labor disruption (LD) seems an appropriate, although crudely measured, variable since the 1974 Vancouver car cycle rose to 28.5 days per car[1] in a year when rail and terminal labor disruptions affected 143 of 220 working days.[2] In summary, ST4, TW and LD are introduced to explain some random year to year factors affecting the car cycle west of Calgary.

---

[1] Jack M.P. Horner, "Submission to the Hall Commission" presented at Consort, Alberta, March 30, 1976, pp. 10. (Mimeographed.)

[2] For example: "Grain Ships Delayed at Vancouver," Globe and Mail, March 1, 1974, p. B.9, and Canadian Wheat Board (1972-73), op. cit., p. 46.

Any reduction in the number of train stops as measured by the number of elevators (NE) would reduce train switching and hence, TM3T. Miles of branchline (MB) was rejected as an explanatory variable because only a portion of train assembly takes place on branchlines while NE reflects elevators on all lines.

The first four variables in 6.2 are quantifiable and, in the author's view, statistically testable, as follow:

$$\mathrm{TM3T} = f\ (\mathrm{ST4},\ \mathrm{TW},\ \mathrm{LD},\ \mathrm{NE1}) \tag{6.2a}$$

6.2a could be estimated with weekly or monthly data over several years. The Canada Grains Council[3] has suggested that multiple car movements and unit trains are two innovations that will provide decreased car cycle and reduced costs. This view is reflected by the accounting addition of car cycle time saved (TM2) as a result of directing producer marketings through inland terminals.

Realized Costs

$$\mathrm{RC3T} = f\ (\underset{+}{\mathrm{GT3}},\ \underset{+}{\mathrm{TM3T}},\ \underset{+}{\mathrm{IR}},\ \underset{-}{\mathrm{MB}},\ \underset{+}{\mathrm{CC3}}) + \underset{+}{\mathrm{IC3}} \tag{6.3}$$

where:

---

[1] C.P. Rail, (1976) op. cit., p. CP-3-1, and author's estimates.

[2] Canadian Wheat Board (1974-75), op. cit., p. 35.

[3] Canada Grains Council (1975-76), op. cit., pp. 39-41.

RC3T = Realized cost, in millions of dollars, for moving all grain in a year by rail,[1]

IR = Inflation rate as measured by G.N.P. deflator,

MB = Miles of "B" category rail lines abandoned,

CC3 = Cost of capital applicable to owned assets, in percent.

Background -- Table 6.1 compares the initial positions on the costs of moving grain as presented to the Snavelly Commission by the railways and provincial governments up to April 30, 1976. Line 3 on deficits indicates the two parties agree that costs are greater than revenue from the statutory grain rate in 1974. Yet the railways show the deficit at $301.7 million compared to the $75.4 million indicated by provincial governments. Costs are 4.37 times grain revenue according to the railways and 1.85 times revenue from the provincial government viewpoint (line 4). This shortfall converts to 41 cents per bushel according to the railways and 10 cents per bushel according to the provinces.[2] Consideration of the branchline subsidies and incidental revenues of $54.3 million reduces the shortfall on statutory rates to 0.72 times cost and 0.15 times cost, respectively (line 6). These losses will be discussed more in the section on policy implications.

The extent of this study does not permit examination of the validity of roadway cost adjustments (line 2b), constant costs (2c),

---

[1] RC3T is defined to also include depreciation and interest costs on government-owned hopper cars.

[2] Author's estimate using tonnages reported and assuming 54 pounds per bushel.

Table 6.1: Total Railway Costs And Revenues For Moving Grain in 1974

| | Railways' Submissions | Provincial Submissions | Difference |
|---|---|---|---|
| | ------------millions $ | ------------- | ------------- |
| 1. Revenue | | | |
| statutory grain | 89.4 | 88.4 | |
| incidental revenue | | .2 | |
| branchline subsidies | N/A | 54.1 | |
| Total: | 89.4 | 142.7 | 53.4 |
| 2. Costs: | | | |
| a. Long Run Variable Costs: | | | |
| 1. roadway, equipment, transportation and other | 143.4 | 119.56 | 53.4 |
| 2. cost of capital | 52.7 | 14.5 | 38.2 |
| 3. transit traffic | 5.7 | 3.7 | 2.0 |
| 4. solely related lines | 60.1 | 19.3 | 40.8 |
| 5. government hopper cars | 5.7 | N/A | 5.7 |
| Total: | 268.0 | 160.5 | 107.5 |
| b. Roadway Costs Adjustment: | 55.5 | N/A | 55.5 |
| c. Constant Cost: | 47.5 | N/A | 47.5 |
| d. Inflation Adjustment | 20.1 | N/A | 20.1 |
| e. Institutional Costs | | 2.6 | 2.6 |
| f. Total Costs: | $391.1 | $163.8 | $227.3 |
| 3. Deficit on Grain Revenue: | $301.7 | $ 75.4 | |
| 4. Ratio of Cost to Grain Revenue: | 4.37 | 1.85 | |
| 5. Deficit on Total Revenue: | $247.4 | $ 21.2 | |
| 6. Ratio of Cost to Total Revenue: | 1.72 | 1.15 | |

Source: Ken W. Stickland, "Issue at Snavelly Commission Hearing," Alberta Transportation, Edmonton, Alberta, May 1976. (Mimeographed.)

and inflation adjustment costs (2d). The Provinces feel these are inadmissible. Until Snavelly rules on the admissibility of these three costs, the author shall assume they are not included.

The Canada Grains Council identified[1] four following avenues for reducing costs realized by railways:

1. Use of hopper cars,
2. Multiple car movements,
3. Unit trains,
4. Branchline abandonment and elimination of duplication.

Model 6.3 on realized costs attempts to include these views of the Canada Grains Council and the provincial governments in a logical manner so as to be of use to policymakers.

The Statement -- Total realized cost for grain movement by rail (RC3T) is defined as long run variable costs to the railways plus costs associated with government hopper cars less institutional costs. Statement 6.3 incorporates six general accounting factors deemed essential for adjusting the 1974 costs (as calculated by the Snavelly Commission) in order to predict costs in future years. These factors are:

1. Measures of output. Whether costs are estimated by allocation, regression, or factoring, measures of output are used.[2]

---

[1] Canada Grains Council (1975b), op. cit., pp. 39-42.

[2] Provinces of Alberta Manitoba, and Saskatchewan, "Submission to the Commission on the Costs of Transporting Grain by Rail", Volume II - C.P. Rail, presented in Winnipeg, Manitoba April 1976, p. 20 (hereinafter referred to as Provinces).

Net ton-miles (GT3) and average car cycle days (TM3T) are introduced in 6.3 as proxies for the many output measures used in estimating[1] roadway, equipment, transportation and other costs (row 2a1 in Table 6.1). TM3T will reflect the effect on cost of using unit trains at inland terminals.

2. The cost of capital (CC3), in percent, varies as general interest rates in the economy and is set annually by the Canadian Transport Commission for purposes of railway costing.[2] The provinces and railways disagree by a total of $79.0 million largely because the railways used a 24.89 percent cost of capital and the provinces used 10.47 percent.

3. Miles of solely related branchlines. If some of the category "B" rail lines solely related to grain were abandoned, the total of solely related costs (line 2a4) would decline in proportion to the miles of abandoned branchline (MB).[3]

4. Institutional costs (IC3). The provinces[4] defined these to include:

---

[1] Ibid., pp. 20-48.

[2] The 1974 level was set by the Transport Commission at 8.9 percent.

[3] Removal of each mile of branchline removes annual on-line maintenance costs and returns (from the sale of right-of-way) capital to the railways for investment elsewhere in the grain system.

[4] Provinces, op. cit., p. 72-78.

a. unnecessarily large yard and road crews,

b. unnecessary circuit in car routing that could be removed by joint running rights.[1]

Should these inefficiencies be corrected or the costs excluded from accepted railway costing, realized costs will go down by the level of institutionalized costs (IC3).[2]

5. Inflation. Future increases to long run variable cost due to inflation is introduced by IR which is crudely measured in this model by the G.N.P. deflator.

In summation, use of the above variables plus the 1974 base data would permit an economist to predict 1975, 1976, and future cost levels. A crude predictive technique like 6.3 is essential since the extensive costing for the Snavelly Commission cannot be anticipated every year.[3] This model has many shortcomings including omission due to measurement difficulty of a variable to reflect the Canada Grains Council suggestion that greater multiple car movements would reduce costs.

Railway Losses

$$RL3 = RC3T - (GT3)(SR) + BS3 + d(GI1) \qquad 6.4$$

---

[1] Joint running rights allows railways to operate over selected portions of the other company's lines.

[2] Step-by-step introduction of joint running rights would not only reduce costs but also improve the car cycle (TM3T) and reduce net ton-miles (GT3) to move a given amount of grain. This effect of the level of IC3 was not introduced to 6.1 and 6.2 because the author felt the effect of joint running rights alone was far less significant than other variables used.

[3] The last comprehension costing of grain was in the 1950's in conjunction with the MacPherson Royal Commission.

where:

RL3 = Railway losses from the movement of grain, in millions of dollars,

(GT3)(SR) = Revenue from grain, in millions of dollars, where (SR) = statutory grain rate per ton-mile giving $\frac{\$}{\text{ton-mile}} \times \frac{\text{ton-miles}}{\text{millions}} = \frac{\$}{\text{million}}$,

BS3 = Branchline subsidies attributable to grain, in millions of dollars,

d(GI) = Cost of operating government-owned hopper cars, in millions of dollars, where (GI) = government investment as measured by the Book value of hopper cars, in millions of dollars; d = coefficient calculating annual fixed costs of interest and depreciation.

Attention to the level of RL3 is vital if Canada is to avoid railway bankruptcies and attract investment to rail transportation. Statement 6.4 is an accounting expression calculating revenues from grain (GT3) (SR) and subtracting realized costs (RC3) before adding subsidies on branchlines (BS3) and reduced costs from government owned hopper cars (d(GI)). Column 2 of Table 6.1 shows RL3 = \$21.2 from the provincial government point of view.

Investment

$$IN3S = f\,(\underset{+}{GT3},\ \underset{+}{CS31},\ \underset{+}{CC3},\ \underset{-}{RL3}) + GI3 \tag{6.5}$$

where:

IN3S = Investment in railway rolling stock and roadbed associated with grain movement, in millions of dollars,

CS31 = Capital stock in grain-related railway rolling stock and roadbed, in millions of dollars, carried forward from the previous year.

The Canada Grains Council[1] showed the vital importance of additional investment by 1980 in locomotives, cars, and roadbed upgrading. Otherwise the System will be unable to handle a billion bushels in 1980.

Statement 6.5 can be separated into two parts: government investment in hopper cars or right of way improvement (GI3) plus a behavioural model:

$$IN3S = f\ (GT3,\ CS31,\ CC3,\ RL3) \qquad 6.5a$$

predicts the induced investment by railways themselves. This behavioural model is supported by theoretical model 2.11 introduced in Chapter II. It, (6.5a), suggests annual investment attributed to a sector (grain) of railway firms varies proportionately to output (GT3), the need to replace existing capital (CS31), and the return on investment (CC3). CC3 is set by the Canadian Transport Commission. Because perceived losses through the early 1970's resulted in little railway investment[2] in boxcars, the author deduces that railways can be expected to withhold needed investment in direct proportion to their losses (RL3) from the movement of grain. While RL3 would be difficult to estimate with historical data,[3] the remainder of model 6.5a should be estimable from current data.

## Policy Implications: Quantitative

Five instrument variables are selected. The logical impact of their level is reflected in Figure 6.3. In addition, institutional changes to the statutory grain rate and branchline subsidies will be introduced. Table 6.2, which lists the positive and negative side effects of the five variable instruments of policy, will be discussed in the selection process for each variable.

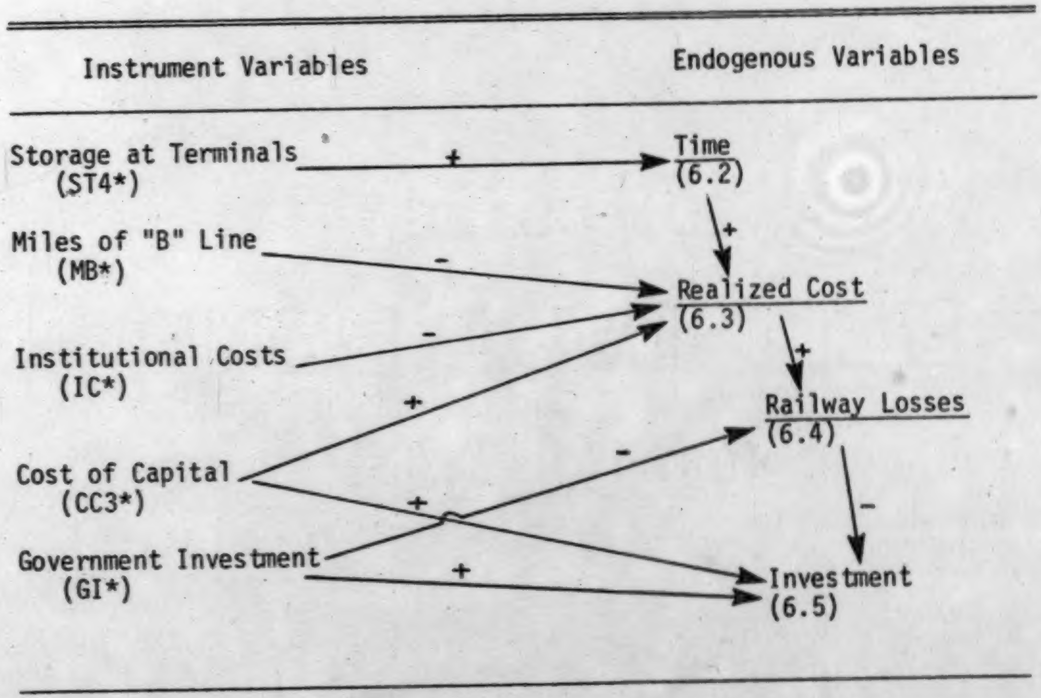
---

[1] Canada Grains Council, (1975b), op. cit., pp. 28-32.

[2] Canada Grains Council, (1973b), op. cit., p. 155.

[3] Railway claims for losses on branchlines could be used as a proxy for the more comprehensive RL3 that includes all losses on grain regardless of origin.

Figure 6.3: Instrument - Target Linkages Selected For Railway Subsystem (#3)


Instrument Variables
Endogenous Variables
Storage at Terminals (ST4*)
Miles of "B" Line (MB*)
Institutional Costs (IC*)
Cost of Capital (CC3*)
Government Investment (GI*)
Time (6.2)
Realized Cost (6.3)
Railway Losses (6.4)
Investment (6.5)
+
-
-
+
+
-
+
+
+
-

Time -- Statement 6.2 introduces five exogenous variables for which all but weather are somewhat open to influence or control by decision-makers.

The level of stocks at terminals (ST4) is selected as an instrument (ST4*) because of the current high degree of control exercised over stocks by the Canadian Wheat Board. The Board uses the block shipping system of car orders to control, on a weekly

Table 6.2: Side effects of instruments selected for railway subsystem (#3)

| Instrument | Reducing Terminal Storage | Reduce Institutional Costs | Decrease Cost of Capital | Increase Government Investment |
|---|---|---|---|---|
| Intended Target | Time | Cost | Cost<br>Investment | Losses<br>Investment |
| Investment - This System | 0 | + | - | + |
| Investment - By Others | 0 | + | - | + |
| Rural Development | 0 | ± | ± | + |
| Competition | + | + | + | - |
| Income Stability | 0 | 0 | 0 | 0 |
| Income Distribution | 0 | 0 | 0 | 0 |
| Spatial Equity | 0 | + | + | + |
| Grain Quality | + | 0 | 0 | 0 |
| Range and Quality of Services | 0 | + | + | + |
| Safety | 0 | - | - | + |
| Air Quality and Energy Consumption | 0 | 0 | - | + |
| Labor Productivity | + | + | - | + |
| Freedom to Allocate Resources | + | + | - | - |
| Grain Handling Coordination | + | + | - | + |
| Livestock Production | 0 | 0 | 0 | 0 |
| Totals + | 5 | 9 | 4 | 9 |
| - | 0 | 2 | 8 | 2 |
| net | +5 | +7 | -4 | +7 |

basis, the incoming terminal receipts.[1] ST4* is somewhat uncontrollable because unexpected variability in ship arrival and breakdowns (like snow slides) in the rail system affect weekly stock levels. The effectiveness, of reducing (ST4*) to allow more working room at terminals and hence faster car unloads (less TM3T) has been accepted and advocated by the Canada Grains Council.[2]

Other variables in model 6.2 are rejected as instruments for the following reasons:

1. The number of country elevators (NE) was judged in subsystem one to be politically unacceptable as an instrument.

2. Quantitative policies to reduce labor disruptions (LD) are beyond the analytic scope of this study. Some of the institutional changes affecting LD are discussed in the next chapter.[3]

3. Weather (TW) is uncontrollable.

TM3T will be affected through TM2 and 5.1 by steering choices for the level of inland terminal tariffs (HT2*) and delivery incentives (DI2*). These inward effects of steering in another subsystem suggest a need for much collaboration between the Wheat Board and the Canada Grain Commission to balance the effects of (HT2*), (DI2*), and (ST4*) in a manner than brings the best benefit to throughput time in both railway and inland terminal subsystems.

---

[1] G.J. Davis and D.G. Stephens, "The Canadian Wheat Board's Terminal Planning Division," in Grains and Oilseeds Handling Marketing and Processing, (Winnipeg: Canadian International Grains Institute, 1973), pp. B-6a, 7-9.

[2] Canada Grains Council (1973b), *op. cit.*, p. 96.

[3] For an overview of the causes, effects and possible policy changes to deal with labor disruptions, see: Justice E.D. Bayda, "Report of the Industrial Inquiry Commission Under the Canadian Labor Code into the Grain Handling Industry in the Vancouver Port Area," Ottawa, Ontario, July, 1975. (Mimeographed.); G.K. Honey, "The High Cost of Strikes in the Food Distribution System," (Calgary, Alberta: Alberta Wheat Pool, December 1975).

The side effects of decreasing the level of terminal storage are small and totally positive as shown in Figure 6.2. The author's evaluation of side effects is that competition and allocative freedom between terminal companies will increase and labor will be more productive as terminals reduce storage stocks.

Realized Costs -- The three following exogenous variables are selected as instruments in order to reduce costs (RC3T) in different sectors of railway costing and operations:

1. Abandonment of "B" lines (MB*) primarily affects the costs of the Prairie system of feeder lines. Some abandonment is advocated by the Canada Grains Council and others as being effective in reducing rolling stock requirements and inflationary on-line costs. This instrument has many side effects evaluated previously in Table 4.2. (MB*) can be simply carried out by implementation of Hall Commission recommendations.

2. Reduction in institutionalized costs (IC3) is selected as a policy instrument (IC3*) not because it has much effect[1] but because the side effects are significantly positive (see Table 6.2) and because, in principle, policy changes should first attempt to reduce unnecessary expenditures. Reduction in institutionalized costs was supported by many citizen groups at local Hall Commission hearings.[2]

---

[1] Table 7.1 shows IC3 at only $2.6 million or 2 percent of total costs.

[2] In addition, see the Provinces, op. cit., p. 72-88.

Reducing institutional costs will take time because it involves a) reducing rail crew size[1] (and hence increasing sensitive union issues) and b) introducing joint running rights.

3. Decreasing the cost of capital rate (CC3) is selected as an instrument (CC3*) to reduce realized costs because of the great impact and administrative simplicity of changes to CC3*. CC3* is already set annually by Canadian Transport Commission decision. Keeping CC3* at a low level to reduce costs is in direct conflict to the high levels of CC3* necessary to affect investment positively (see statement 6.5). Upon numerical estimation, a comparison of the coefficients of CC3*) in 6.3 and 6.5 would suggest the trade-offs between cost and investment. If policymakers set RC3T at a low level and IN3S at a high, minimum limit, then CC3* would take a middle position thereby losing its potential as an instrument. Other variables in models 6.3 and 6.5 would have to therefore be steered to cause the desired changes in RC3T and IN3S. Additional abandonment of "B" lines (MB*) and additional government investment (GI*) have the effiency to take up this slack.

Side effects are shown in Table 6.2: eight criteria were judged to be negatively affected by a decrease in CC3*. However, rural development, spatial equity and the range and quality of services were judged to be positively affected by a decrease in CC3* because reduced cost on branchlines would reduce pressure to abandon branchlines. Lower costs would also make rail more competitive with trucks.

---

[1] Extra crew costs for the C.P.R. were estimated by the provinces at $761,418 compared to $52,596 for circuitous routing of rail cars. Provinces, op. cit., p. 88.

Investment -- Autonomous investment by the Federal or provincial governments (GI3*) is selected as a second instrument variable affecting investment in 6.5. Government assistance in building railway services for the Prairies goes back to the first building of the transcontinental C.P.R. line. Also, since 1970, the Government of Canada has purchased 6,000 hopper cars. These precedents suggest to the author that direct funding has been deemed more effective than the investment tax credits or depreciation write-offs used to stimulate investment in other subsystems. The analysis of side effects in Table 6.2 suggests increasing GI* has nine positive effects and only negatively affects the railways' freedom to allocate resources and the competition between firms to innovate.

Increasing GI* has the added benefit of including government preferences in the nature and location of investment. The resources for this study did not permit the ranking of specific investment ideas raised by the citizens and numerous grain industry groups who presented their views to the Hall Commission. Following is a list of investment options for governments and/or railways that merit some attention in the author's view:

1. Repair existing boxcars,
2. Buy more new light (90 ton) hopper cars,
3. Rehabilitate "B" category branchlines that the Hall Commission recommends for retention,
4. Double tracking portions of C.N. and C.P. main lines in British Columbia,
5. Construct new linkages recommended by the Hall Commission,

6. Acquire additional access between the north and south shores of Vancouver's rail network,

7. Construct a line connecting Ashcroft and Clinton, British Columbia,

8. Build additional switching and assembly yards in the B.C. interior or lowland east of Vancouver.

The wholesale public purchase of all railway roadbed in Western Canada (as advocated by the provinces at the Western Economic Opportunity Conference) is too complex an issue for this study. While such a widespread reform would place railways on an equal footing with the public ownership of roads, the huge capital investment would seem prohibitive in this time of high interest rates and large Canadian capital needs in the energy field. Furthermore, since purchasing roadbed only redistributes the cost, it would appear to produce less effect on long run costs to all parties, per dollar invested, than the eight options listed above.

### Policy Implications: Institutional

While instrument adjustment will annually assist policymakers in their steering of this subsystem, the author sees the five selected instruments as insufficient to cause reduced TM3T, substantial savings in RC3T, reductions in RL3, and hence higher IN3S. Background and a proposal regarding the statutory grain rate and grain subsidy mechanism are identified below.

## Background

The need for changes in the current level and structure of the statutory grain rate and branchline subsidies has been clearly documented. The Canada Grains Council,[1] C.P. Rail,[2] C.N.R.,[3] and Kulshreshtha[4] argue that the current low grain rate discourages railway investment or abandonment of some branchlines that would mutually benefit elevator firms and railways. The Food Prices Review Board supports these views and adds that the rate is a "covert subsidy"[5] accruing to Eastern livestock feeders in a manner than handicaps Western Canadian livestock producers. The Canadian Cattle Commission points out that the Western hog and livestock industry will "gradually die if transportation rates on its major input are fixed and/or subsidized, but rates on its product (meat and live animals) continue to escalate with inflation."[6] The Alberta Government adds that the "method in which (Crows Nest) rates are applied has tended to discourage value added processing, and implicity, employment opportunities within the Prairie region."[7] Dever adds that the "real benefits to grain producers have been exaggerated...while benefits are being eroded by (1) increased rates on agricultural inputs, (2) increased taxes, and (3) restricted capability to market grain."[1] An additional reason for a rate change is that railways and governments alike have shown that grain in 1974 moved at substantial losses. (See Table 6.1).

---

[1] Canada Grains Council (1973b), op. cit., p. 23.

[2] C.P. Rail, "Submission to the Grain Handling and Transportation Commission" (presented in Winnipeg, Manitoba, October 1975), p. 10.

[3] C.N. Rail, "Submission to the Grain Handling and Transportation Commission" (presented at Winnipeg, Manitoba, October 1975), p. 7.

[4] Kulshreshtha (1975a), op. cit., pp. 13 - 22.

[5] Food Prices Review Board, Feed Grains Policy in Canada (Ottawa: Food Prices Review Board, December, 1975.), p. X.

[6] Canadian Cattle Commission, "Submission to the Hall Commission" (presented at Calgary, Alberta, November, 1975), p. 5.

[7] Government of Alberta, Submission to the Grain Handling and Transportation Commission (Edmonton: Alberta Transportation August, 1975), p. 7.

Political momentum has also been growing for a change in the method of paying railways for the costs of moving grain. This is exemplified by the following Canada Grains Council resolution sent to Hon. O. Lang on January 6, 1975:

> The Grain Handling and Transportation Committee supports retention of the Crows Nest rates for export grain as a direct charge to the producer, and recommends that the railways be compensated for the movement of grain at a level and in such a manner that will ensure the provision of adequate service, and that the Grain Handling and Transportation Committee initiate studies to indicate how best such compensation can be provided.[2]

The railways subsequently advocated grain subsidies be paid directly to farmers in a manner that retains the effect of statutory rates. While the United Grain Growers[3] and Cargill[4] describe a restructuring of the method of subsidizing export grain, both also prefer retaining the statutory rate level to farmers. Provincial governments have concurred that statutory rates are "an invoilate commitment of the Federal

---

[1] D.A. Dever, "The Effects of the Crowsnest Pass Railway Rates," Crows Nest Transportation Seminar Papers (Edmonton: Rural Education and Development Association, 1975), p. 97.

[2] Dever, op. cit., p. 99.

[3] United Grain Growers, "Submission to the Grain Handling and Transportation Commission of Inquiry," Winnipeg, Manitoba, 1975, appendix D.

[4] Cargill, op. cit., pp. 51-61.

Government and railways to the Western Canadian farmers."[1]

Despite the above viewpoints maintaining that the statutory rate is an invoilate commitment of the Federal Government to Western Canadian farmers, the attitudes at the farm and community level may be changing. Unifarm[2] proposed the farmer should pay full realized costs yet be reimbursed through the Grain Stabilization Plan so that only the benefit of the statutory rate remains inviolate.

The author also observed in 1976 that up to 30 percent of the spokesmen during twenty-five days of local hearings of the Hall Commission in Alberta preferred an increase in the statutory rate as opposed to abandonment of their line. That is, if Snavelly shows costs are greater than revenues, these farmers said they would pay 5 to 10 cents per bushel in excess of their current rate. However, they would not pay more than double the current statutory rate. Doubling the rate would be an increase of 12 or 13 cents per bushel, on average. The political factor which may bring an increase to the statutory rate is Wheat Board Minister Otto Lang's policy of May 1976 to implement fully compensatory rates on the movement of rapeseed products.[3]

From the range of presentations to the Hall Commission, the author concluded the existing branchline subsidy mechanism should have its role reduced because of the following side effects:

---

[1] Government of Alberta, op. cit., p. 7.

[2] Unifarm, "Brief to the Grain Handling and Transportation Commission" (presented in Edmonton, Alberta, November 1975), pp. 8 - 9.

[3] Transport Canada, "Lang Comments on Rapeseed Freight Rate Changes" (Ottawa: Directorate of Public Affairs, Transport Canada, May 4, 1976), p. 1.

1. The subsidy does not fully cover losses from grain movement (see Table 6.1).

2. "The subsidy erodes the railways" motivation to abandon branchlines."[1]

3. The existence of a subsidy is no guide to the profitability of a line and hence, whether it is likely to be abandoned.[2] Allocation of all off-line costs and therefore, subsidies to each branchline, tends to create the impression that branchlines, not grain, are causing losses. Since subsidized branchlines tend to be outside the major transportation and population corridors, the burden of losses associated with grain fall only (and therefore, disproportionately) on the isolated areas. This places these areas in an even poorer light in terms of industrial development. It follows that favouring the branchline subsidy mechanism implies disagreeing with policies that decentralize economic activity.

4. The many changes to the subsidy program since its 1967 enactment have left small communities and farmers along branchlines in a constant state of uncertainty.

5. These subsidies contain no incentives for railways to reduce operating costs, introduce efficiencies, or rehabilitate lines. In fact, the designation of a line as a "loser" tends to cause railways to cut back on rehabilitation and to reduce possible overhead traffic on through lines. The routing of eastbound Halkird coal west, south, and then east on C.P. track rather than straight eastward on the sub-

---

[1] United Grain Gorwers, op. cit., p. 32.

[2] Ibid., p. 32.

Table 6.3: Side Effects Of Institutional Policy Changes For The Railway Subsystem (#3)

| Institutional Change | | Changes to Statutory Rate and Subsidies |
|---|---|---|
| Side Effect: | | |
| Investment - this system | | + |
| Investment - by others | | + |
| Rural Development | | + |
| Competition | | + |
| Income Stability | | 0 |
| Income Distribution | | - |
| Spatial Equity | | - |
| Grain Quality | | + |
| Range and Quality of Services | | + |
| Safety | | 0 |
| Air Quality and Energy Consumption | | 0 |
| Labor Productivity | | + |
| Freedom to Allocate Resources | | + |
| Grain Handling Coordination | | + |
| Livestock Production | | + |
| Totals | Positive | 10 |
| | Negative | 2 |

sidized Coronation subdivision is an example of car circuitry fostered by the subsidy system.

Proposal

The author believes the following proposal to be efficient, politically acceptable, and reasonably simple to implement. The author recommends that a Grain Transportation Package be introduced by Parliament to amend the National Transportation Act according to the following guidelines:

1. Double the statutory rate on export grain, the rate being reflected to the farmer in his initial payment, and remove the statutory rate on domestic movements of all grains to Thunder Bay.

2. Establish maximum transportation tariffs according to realized costs of moving grain as established by the Snavelly Commission. Tariffs for each freight zone on the Prairies would be some multiple of the statutory rate. (Example: three times the current rate). A Federal Export Grain Transportation Subsidy would be established to reimburse elevator companies for any difference between the maximum tariff and the statutory rate.

3. If an elevator company were to install a new more efficient elevator capable of reducing the railway's cost (by multiple car or unit train origination), the company would be free to negotiate a lower rail rate. The Government's liability to the elevator company would still be the difference between the maximum transportation tariff and the new statutory rate.

4. Introduce an incentive subsidy to the railways to encourage fast rail movement in periods of high grain prices and/or volumes.

Paid as a small percentage of grain export revenue (say 1 percent), the incentive would commence at volumes over some threshold (say, 500 million bushels). It would be financed by the Grain Stabilization Plan, whose revenue source includes two government dollars for every farmer dollar.

5. Retain the branchline subsidy mechanism to be paid only if the Grain Transportation Subsidy does not cover losses on low density lines judged essential by the Hall Commission to the year 2000.

Evaluation of this proposal - Section one of the proposal recognizes that the chief user (the farmer) should pay more than at present. By removing the rate from all domestically consumed feed and food grains, livestock and other value-added economic activity should be encouraged in Western Canada as compared to other parts of Canada.

Sections two and three are taken from the U.G.G.[1] and Cargill[2] proposals and would encourage grain companies to invest in new grain handling facilities in order to gain comparatively cheaper freight rates. Grain company windfalls from the Federal Treasury as a result of lower freight rates would be passed on to farmers as compensational incentives for delivery (DI1 and DI2).

Cargill suggested an incentive for railways to move large quantities of grain when price or quantities were above normal. Section four of the above proposal adds some mechanics to such an incentive. The Federal Treasury pays the subsidy yet would receive financial benefits on behalf of all Canadians through a more favorable balance of trade and higher farm income taxes. This incentive would also encourage the quick solution of railway strikes. By attaching the incentive to the Grain Stabilization Plan, this author's proposal would pay out when farmers were well off, and hence, the freight rate would be somewhat related to ability to pay (as measured by the net farm income criteria in the plan).

---

[1] United Grain Growers, op. cit.,

[2] Cargill, op. cit.,

Section five would retain branchline subsidies so as to implement the equity and isolation criteria of national transportation policy. The reduced role of branchline subsidies would remove most of the negative effects (identified earlier) of the existing subsidy program.

Table 6.3 describes the author's assessment of any side effects of this mix of institutional changes. On balance, the effects are seen as highly positive with nine positive and only two negative effects. The more serious negative implications in equity for smaller farmers and those in areas of branchline abandonment will be dealt with by compensation proposals in subsystem #9.

## Summary

Subsystem 3 uses five statements to show the relationship between five instruments and two target variables (TM3T, RC3T) plus one inhibiting condition (IN3S). Dockage entering elevators and time saved by the inland terminal subsystem are two inward linkages from other subsystems that affect variables in this railway subsystem. Institutional charges to the block shipping system and the method of paying railway costs were introduced and evaluated.

# CHAPTER VII

# PORT TERMINAL SUBSYSTEM

## Introduction

This subsystem reflects the key model variables for the twenty-eight terminals at Vancouver, Victoria, and Prince Rupert, Churchill and Thunder Bay. Because Vancouver and Thunder Bay are competitive ports with more than four operators each and most Prairie grain goes through these two ports, this subsystem is judged to be effectively competitive.

Terminals provide the following functions:[1]

1. Unloading of rail cars;
2. Accumulation and preparation of quantities of grain of uniform quality for loading on vessels or for forwarding by truck or rail to domestic consumers;
3. Storing of grain to the extent required:
    (a) to buffer between the fluctuations of rail and vessel arrival,
    (b) to provide for market demand and sales positions;
4. Loading of grain on board vessels or into rail cars or trucks;
5. Cleaning, drying and processing of grain to required standards.

Target variables selected for subsystem #4 include:

1. Realized cost to the terminal operators (RC4T).
2. Time in the terminal subsystem (TM1T).
3. Total profits to terminal firms (TP4T).

Additional investment (IN5S) to improve throughput is identified as a condition inhibiting movement towards targets.

---

[1] Canada Grains Council (1973 b). op. cit., p. 4.

## Structural Relationships

Figure 7.1 outlines the variables and their logical interactions are developed in this chapter. No model is developed for the price reflected to farmers since the handling and cleaning tariffs are currently paid first to the Canadian Wheat Board and only indirectly by the farmer through deductions from the final Canadian Wheat Board payment. The limits of this study did not permit special assessment of Prince Rupert and Churchill ports[1] yet the general model variables should apply equally. Each relationship would be most accurately estimated by using two sets of data (for Vancouver and Thunder Bay) and, hence, deriving two regression models. For simplicity, only one of each model will be shown. At the time of preparation of this study, major studies were being conducted by the Canada Grains Council on grain movement through Thunder Bay[2] and Vancouver[3]. The author incorporated some of the Council's hypotheses and anticipates that its reports will quantify some of the relationships that follow.

Dockage

$$DE4 = f\ (\underset{+}{TR4},\ \underset{-}{IT2},\ \underset{-}{CT4},\ \underset{+}{DE1}) \qquad 7.1$$

where:

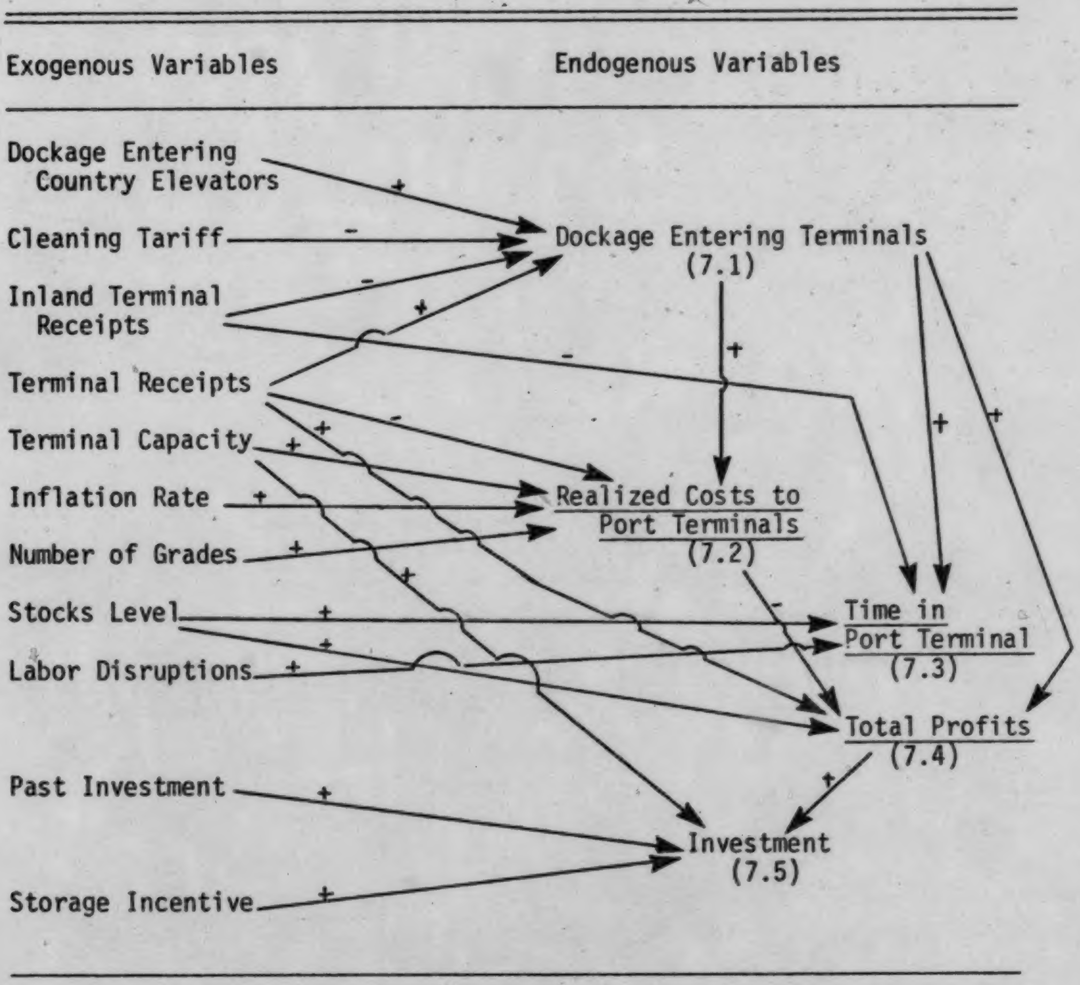
---

[1] For an assessment of the variables and policies affecting these ports see: Grain Co-ordination Committee, "The Case for Expanded Grain Facilities in Prince Rupert", Prince Rupert, 1975. (Mimeographed.); John F. Dierckz, "Grain at Prince Rupert," Department of Transportation, Edmonton, Alberta, 1975. (Mimeographed.); Port of Churchill Development Board, "Submission to the Grain Handling and Transportation Commission" (presented at Winnipeg, Manitoba, March 1976). (Mimeographed.)

[2] A.N. Kaplanis, "Review of Activities of the Thunder Bay Sub-Committee," Winnipeg, Canada Grains Council, 1976, pp. 1-8. (Mimeographed.)

[3] D.R. McRae, "Report on the Activities of the Pacific Coast Sub-Committee," Winnipeg, Canada Grains Council, 1976, pp. 1-12. (Mimeographed.)

Figure 7.1: Logical relationships among variables endogenous and exogenous to (port terminal) subsystem (#4)


Exogenous Variables
Endogenous Variables
Dockage Entering Country Elevators
Cleaning Tariff
Inland Terminal Receipts
Terminal Receipts
Terminal Capacity
Inflation Rate
Number of Grades
Stocks Level
Labor Disruptions
Past Investment
Storage Incentive
Dockage Entering Terminals (7.1)
Realized Costs to Port Terminals (7.2)
Time in Port Terminal (7.3)
Total Profits (7.4)
Investment (7.5)
+
-
-
+
-
+
+
-
+
+
+
+
+
+
+
+
-
+
+
+
+

DE4 = Dockage entering port terminals during a year, in millions of pounds,

TR4 = Terminal receipts (Pacific Coast, Churchill, and Thunder Bay), in millions of bushels,

IT2 = Inland terminal receipts, in millions of bushels,

CT4 = Cleaning tariff at port terminals, in cents per bushel,

DE1 = Dockage entering country points, in millions of pounds.

That dockage is of vital importance to port terminal costs and throughput has been clearly identified by the Canada Grains Council.[1] Although dockage is only 2 to 4 percent of terminal receipts, its importance is far greater because of the time and cost of cleaning. Model 7.1 is a supply function for a derived product of grain. That is, the level of dockage (DE4) is hypothesized to vary most significantly in relation to the terminal receipts (TR4).[2] Any change in the price or tariff for processing (CT4) will inversely affect the actual dockage moved forward over a period of several years. Competitive locations for removing dockage exist at inland terminals so the dockage at ports would decline in those years when inland terminal handlings (IT2) increased. Finally, dockage levels vary from year to year according to harvesting conditions and the volume of dockage entering the grain handling system (DE1). This effect of country elevator dockage levels (DE1) would be especially felt at Thunder Bay where particularly tough or high dockage grain is moved forward early in the shipping season to utilize cleaning and large storage capacity. Data are currently available for all variables of model 7.1 so 7.1 could be estimated and tested.

---

[1] Ibid, pp. 1-12.

[2] Unlike other subsystem models, this chapter will not introduce a separate statement explaining subsystem throughput since:
i. terminal receipts are in fact exogenously set by administrative decisions of the Wheat Board through matching forward movements ordered by the block shipping system with dates and levels of anticipated sales;
ii. possible explanatory variables like variability in ship and rail car arrivals, labor disruptions, and export price are so interrelated that multicollinearity between explanatory variables would be very high. These can only be tested using computer facilities unavailable to the author. The possible variables affecting throughput will be reviewed in the policy implications section.

Realized Costs

$$RC4T = f\,(\underset{-}{TR4},\ \underset{-}{DE4},\ \underset{+}{TE4},\ \underset{+}{IR},\ \underset{+}{NG}) \tag{7.2}$$

where:

RC4T = Realized costs of all terminals at a port, in millions of dollars,

TE4 = Terminal storage capacity at a port, in millions of bushels,

IR = Inflation rate, measured by an index of wage levels in the province of the terminals.

NG = Number of grades of grain.

Model 7.2 is a time-series cost function estimable by extending the two sets of cost data for Thunder Bay and Vancouver used in a Canada Grains Council analysis of terminal costs.[1] Variable costs would vary as a function of clean bushels (TR4) and dockage (DE4) handled while fixed costs would vary only with changes to storage capacity (TE4). Over time, the variable costs would inflate largely as a function of wages incorporated in the wage inflation rate (IR). Reductions in the number of grades (NG) and/or increases in foreign matter tolerances are generally felt to reduce terminal costs.[2] The Canada Grains Council expects inflation and volume to be the variables explaining the largest changes in cost.

---

[1] Canada Grains Council (1975 b), op. cit., pp. 21-24.

[2] See H.D. Pound, "The Role of the Canadian Grain Commission in Modernization" (Address to Semi-Annual Meeting of Canada Grains Council, Edmonton, Alberta, October 28, 1974), pp. 7-10.

Time

$$TM4T = f\ (\underset{+}{ST4},\ \underset{+}{DE4},\ \underset{+}{LD},\ \underset{-}{IT2}) \qquad 7.3$$

where:

TM4T = Time in the terminal subsystem measured in days,

ST4 = Stock levels, normally maintained in the terminals, in millions of bushels,

LD = Labor disruptions as measured in percent of total working days that the grain handling and transportation system is affected by labor shutdowns in various sectors.

Model 7.3 is a technical model of the throughput and efficiency of terminals. (TM4T) could be estimated from engineering data or historical operating records. The Wheat Board indicated[1] that throughput decreases as stocks move upward from 50 percent of capacity, handling capacity decreases rapidly as stocks move to 85 million bushels, or 84 percent, at Thunder Bay and 78 million bushels, or 72 percent, at Vancouver. Hence TM4T varies directly as ST4. Bjarnason[2] and C.D. Howe, Western Ltd.[3] have concluded that throughput time increases as requirements for drying and processing (DE4) increase since cleaning is a key limiting factor in Vancouver. The Wheat Board[1] and Bjarnason[2] noted that labor disruptions at ports or in the rail system decrease throughput and hence increase TM4T. This view is reflected by (LD). As shown by the special trucking programs from 1971 to 1975, time in the port terminal declines in proportion to the extent to which special programs are introduced to clean and dry grain at inland terminals and forward it by unit trains. These programs are measured by inland terminal receipts (IT2).

---

[1] C.J. Davis and D.G. Stephens, "The Canadian Wheat Board's Terminal Planning Division," Grains and Oilseeds Handling Marketing and Processing (Winnipeg: Canadian International Grains Institute, 1973), pp. 7-9.

[2] Bjarnason, op. cit., p. 30.

[3] C.D. Howe, Western Ltd., "Report on Potential for Expansion of Vancouver Grain Terminals" (report to Harbors Board, Vancouver, June, 1972), pp. 1-16. (Mimeographed.)

Additional technical factors were rejected from model 7.3 because of measurability difficulty and in order to keep the model simple. Some of the factors expected to improve throughput as suggested in studies by C.D. Howe, Western Ltd.[3] and Bjarnason[4] are:

1. Reduction in the variability of rail car arrival.
2. Reduction in the variability of ship arrival through changes to dispatch and demurrage.
3. Railway investment in hopper cars and additional trackage along terminals.
4. Increasing terminal operations from five to seven day operations.

Total Profits

$$TP4 = (ST4)(SC) + (HC4)(TR4) + (BP)(DE4) - RC4T \qquad 7.4$$

where:

TP4 = Total profits, in millions of dollars,

SC = Storage charge, in dollars per bushel,

---

[1] Canadian Wheat Board (1974-75), op. cit., pp. 35-37.

[2] Bjarnason, op. cit., p. 30.

[3] C.D. Howe, Western Ltd., op. cit., p. 2.

[4] Bjarnason, op. cit., p. 35.

HC4 = Handling and cleaning tariff, in dollars per bushel,

BP = By-product price, in dollars per pound.

Model 7.4 subtracts revenues from costs to get profits. It is an accounting equation incorporating the revenue estimation techniques used by the Canada Grains Council.[1] Stocks (ST4) times storage rate (SC) provides storage revenue; the handling and cleaning tariffs (HC4) times receipts (TR4) provides revenue from handling. The price of by-products (BP) times receipts of dockage (DE4) provides by-product revenue. The Grains Council estimated that handling generates over half of the total revenue.[2]

Investment

$$IN4S = f\ (\underset{+}{TP4},\ \underset{+}{TE4},\ \underset{+}{IN41},\ \underset{+}{SI4}) \qquad 7.5$$

where:

IN4S = Investment in port terminals, in millions of dollars,

SI4 = Storage incentive measured by guaranteed revenue per year, in millions of dollars.

Model 7.5 uses statement 2.8 (see Chapter II) as its base. Total profit (TP4) is substituted as a measure of output because it not only accounts for output (terminal receipts) but the squeeze of inflation. Total terminal capacity (TC4) is substituted as the measure of capital stock to explain investment variability due to replacement. Past investment (IN41) is entered to reflect competitive investment by other firms which is a stimulus to new investment (IN4S).

---

[1] Canada Grains Council (1975 b), op. cit., pp. 21-24.

[2] Ibid.

The storage incentive (SI4) reflects the Wheat Board incentive[1] introduced in April 1976 to expand storage at Vancouver by 14 million bushels. This scheme, which will cost between $1.5 and $2.0 million of farmers' money per year, guarantees a storage revenue of 12 cents per year until 1985 for 90 percent to 100 percent of elevator storage capacity provided expansion is undertaken by May 30, 1976. (SI4) will vary as the combined size of old and new storage capacity. Its effect should be measurable as this study goes to print.

Several variables were rejected from this model. Investment by the railways into Vancouver yards and trackage may encourage complementary terminal investment. Yet measurement of such investment is difficult. (IN3S) includes investment at all locations in the Prairies and ports so it could not be used for model 7.5. A variable reflecting technology could have been tested since large expenditures have recently been made by terminals for pollution control equipment. A technology variable was omitted to keep the model simple and because past investment would somewhat reflect the effects of new technology.

---

[1] Nick Hills, "Money to Ease Grain Flow," Winnipeg Tribune, April 14, 1976, p. 10.

## Policy Implications

### Instrument Selection

Figure 7.2 shows that eight instruments affect the three target variables of cost, time and profits. One variable, labor disruptions, can be influenced by structural policy changes identified in the next section. Three instruments were previously selected for other subsystems and affect subystem targets with inward linkages as follows:

1. As the cleaning tariff at the country elevator (CT1*) increases, dockage (DE1) will decrease (4.1) and hence dockage entering terminals (DE4) will decrease (7.1). A decrease in dockage reduces realized costs (7.2), time in the terminal (7.4), and revenue from sales of by-products (7.4). Figure 7.2 clarifies these inferences.

2. As the handling and cleaning tariff at inland terminals (HT2*) increases, inland terminal receipts decrease (model 5.1) and hence time at port terminals increases (7.4).

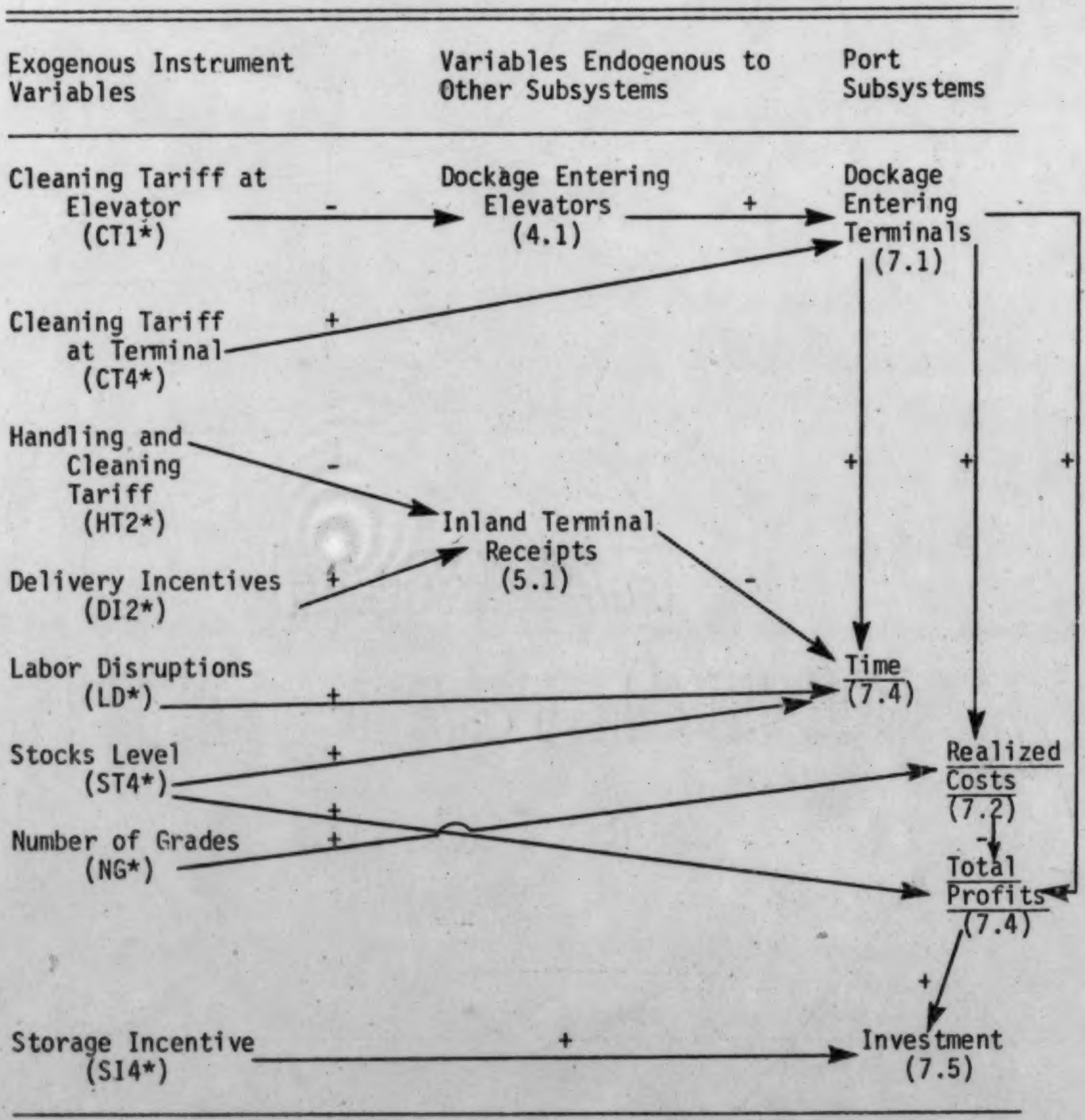
3. As delivery incentives to inland terminals increase (DI2*), inland terminal receipts will increase and hence time at port terminals decreases (7.4).

The four remaining instruments in Figure 7.2 are next selected and evaluated.

### Cleaning Tariff

Decreases to the tariff for grain cleaning is selected as an instrument (CT4*) that will reduce dockage entering terminal (DE4). CT4* will indirectly reduce realized costs (7.2) while reducing the

Figure 7.2: Instrument-target relationships affecting port terminal subsystem


Exogenous Instrument Variables
Variables Endogenous to Other Subsystems
Port Subsystems
Cleaning Tariff at Elevator (CT1*)
Dockage Entering Elevators (4.1)
Dockage Entering Terminals (7.1)
Cleaning Tariff at Terminal (CT4*)
Handling and Cleaning Tariff (HT2*)
Inland Terminal Receipts (5.1)
Delivery Incentives (DI2*)
Labor Disruptions (LD*)
Time (7.4)
Stocks Level (ST4*)
Realized Costs (7.2)
Number of Grades (NG*)
Total Profits (7.4)
Storage Incentive (SI4*)
Investment (7.5)
-
+
+
-
+
-
+
+
+
+
+
+
+
-
+
+

time required to move grain through the terminals (7.4). The level of the cleaning tariff is a simple, annual choice set by the Canada Grain Commission as an upper limit. Because tariffs are published, changes are clear signals to all stakeholders throughout the grain handling and transportation system. The Commission used this instrument in 1975 to discourage dockage flows to ports. The effectiveness of keeping the Commission (CT4*) constant was increased by simultaneously increasing the country point tariff level (CT1) and thereby discouraging the entrance of dockage to the system (DE1) while encouraging inland cleaning.

The assessment of side effects shown in Table 7.1 indicates that reducing or holding CT4* constant has five negative effects. It will over several years tend to decrease investment at terminals, plus decrease grain quality, the level and range of cleaning services, and freedom to allocate the location of cleaning. With less profit from cleaning, firms will minimize expenditures to reduce pollution and to conserve energy. In the author's view the (six) positive effects outweigh the negative effects. Dockage removal will be encouraged on the Prairies with resulting benefits to rural development, competitive cleaning, and livestock production. With cleaner grain entering the terminal, the work environment and correspondingly, labor productivity should increase. Additionally reducing the cleaning tariff should provide greater income stability for the farmer because he will have greater diversified services near home and less bottlenecks at the delivery point for his product (the port).

### Number of Grades

The number of grades is selected for this subsystem as an instrument (NG*) to reflect a relaxation of Canada Grains Commission specifications for both the number of grades and tolerances for foreign

Table 7.1. Side effects of instruments selected for port terminal subsystem (#4).

| Instrument | Reduce Cleaning Tariff | Reduce Number of Grades | Reduce Terminal Storage Stocks | Increase Storage Incentives |
|---|---|---|---|---|
| Intended Targets | Cost, Time, Profits | Cost | Time, Profits | Investment |
| Investment - this system | - | 0 | 0 | + |
| Investment by others | + | + | - | + |
| Rural Development | + | - | + | - |
| Competition | + | - | + | - |
| Income Stability | + | + | 0 | + |
| Income Distribution | 0 | 0 | 0 | 0 |
| Spatial Equity | 0 | + | 0 | 0 |
| Grain Quality | - | - | + | + |
| Range and Quality of Services | - | 0 | + | + |
| Safety | 0 | 0 | 0 | + |
| Air Quality and Energy Conservation | - | 0 | 0 | 0 |
| Labor Productivity | + | + | + | + |
| Freedom to Allocate Resources | - | + | + | + |
| Grain Handling Coordination | 0 | + | + | + |
| Livestock Production | + | 0 | 0 | 0 |
| Totals: positive | 6 | 6 | 7 | 9 |
| negative | 5 | 3 | 1 | 2 |
| net | +1 | +3 | +6 | +7 |

matter. Pound[1] cited the instrument's importance and the 1971 precedent of reducing the number of grades from 500 to 25. A current Grains Council assessment of the impact of foreign matter tolerances on terminal throughput should, when finished, give some indication of the impact of (NG*). According to the author's assessment of side effects in Table 7.3, reducing (NG*) will benefit the handling system yet reduce competitive grading in the country and reduce the quality of grain sold to the buyer. Rural development is judged as negatively affected because grades identify comparative advantage between regions; therefore, make grades (like protein grading at elevators) should increase rural incomes by causing farmers to grow the crop with the greatest comparative advantage. Conversely, fewer grades would reduce rural development. For example, by adding protein segregation, good wheat growing regions would be encouraged to grow high protein when while poor wheat areas would change to barley and low quality wheats with better volume advantages for their areas. On balance, farmers in both areas should be better off.

In summary, reducing (NG*) has mixed side effects that can only be evaluated against operational advantages through additional study and clear weighting by policy makers of the trade-off between additional terminal efficiencies as opposed to reduced rural development, competitive grading, and quality reputation with the buyer.

Storage Levels

Reducing the level of storage stocks at terminals is identified as an instrument (ST4*) because it was shown in the development of the model to be (a) effective and (b) currently used by the Wheat Board to reduce congestion and hence time in terminals. The side effects in Table 7.3 are, on balance, positive. However, reducing terminal storage stocks will require additional storage capability inland: on farms, at country elevators, or at inland terminals.

---

[1] Pound, op. cit., p. 9.

Storage Incentive

The Wheat Board introduction of an incentive (call it (SI4*) to increase investment in storage at Vancouver has these advantages:

1. Simplicity and speed of implementation,
2. Controllability within the grain handling system,
3. Provision of food reserve capability,
4. Future certainty for investors in port terminals.

However, the incentive has four disadvantages:

1. The two month deadline for new investment proposals effectively acts as a barrier to entry by new firms.

2. It's cost is totally borne by the farmer when (a) other elements of the system (like railways) and (b) world buyers or nations in need of emergency food also benefit.

3. It does not provide any incentive to implement the four alternatives for improving terminal throughput that were outlined in the discussion of (7.4).

4. The incentive does not encourage new technology in storage, loading, or cleaning.

To offset these disadvantages, (SI4*) could have been introduced along with an investment incentive, investment tax credit or fast write-off of depreciation. These tax-related incentives would have reduced the incentive cost to farmers and distributed part of the responsibility for providing an incentive to the other benefactors, i.e., the Canadian economy. While changes to the tax act are slower to implement, introduction of a tax incentive in the May, 1976 Federal budget speech would have been politically very acceptable and nearly as quick in its effect as (SI4*). Furthermore, the regulations for a tax incentive could have been written so as to encourage new technology and new terminal operators.

### Institutional Policy Changes

The great impact of labor disruptions (LD) on ports, grain exports, and the Canadian economy was identified in Chapter I. Following is a list of some of the policy alternatives. An assessment of their merit is beyond the scope of this study.

Bayda[1] identified eight union groups (including railway employees) that effect Vancouver grain handling. In making his recommendations, Bayda[2] found "no panacea" to solve the problems but ruled out abolition of strikes in favor of (a) removing the causes of strikes and (b) introducing government as a "defender and promoter of the public interest." Among the twenty-two specific recommendations were these suggestions:[3]

---

[1] Hon. Mr. Justice E.D. Bayda, "Report of the Industrial Inquiry Commission Under the Canada Labor Code into the Grain Handling Industry in the Vancouver Port Area," Office of the Minister of Labor, Ottawa, July, 1975. (Mimeographed.)

[2] Ibid., pp. 45-55.

[3] Ibid., pp. iii-v.

1. To institute and maintain positive industrial relations programs at the terminals;

2. To introduce a government overseer to whom collective bargaining and strike periods of ten days duration were automatically accountable;

3. To reduce the number of bargaining units;

4. To involve labor representatives in Canada Grains Council and Canadian International Grain Institute activities.

Bjarnason[1] assessed labor relation improvements in Vancouver in terms of their effect on throughput. He concluded that:

1. Joint bargaining by Grainworkers' Union, International Longshoremen's and Warehousemen's Union and the Public Service Alliance of Canada would increase throughput by 10 percent.

2. Joint labor/management action to improve the quality of life on the job (job design) would also increase throughput by 10 percent.

3. Increasing the work week from five to seven days would increase throughput by something less than 40 percent.

## Summary

The five models introduced in this subsystem on port terminals contain twelve variables exogenous to the subsystem. Two variables (dockage and inland terminal receipts) are determined endogenously in other subsystems. It would appear that external decisions by the Wheat Board on terminal receipts is the single most vital factor in all statements. Labor disruptions are a close second in importance. Limitations of the Model did not permit showing the effect of railway operating and investment changes in the lower B.C. mainline, nor the many technical variables capable of increasing terminal throughput.

---

[1] Bjarnason, op. cit., p. 37

Three instruments (CT1*, HT2*, and DI2*) aimed at other subsystems have spill-over effects on port terminals. Cleaning tariffs at the port, the number of grades, stock levels and a storage incentive were selected as instruments capable of affecting subsystem targets. Institutional policy alternatives for reducing labor disruptions were reviewed. The next chapter discusses two other institutions affecting port terminals.

# CHAPTER VIII

# CANADIAN GRAIN COMMISSION AND CANADIAN WHEAT BOARD SUBSYSTEMS

## Introduction

Chapter VIII identifies the functions and logical relationships of factors affecting the Canadian Grain Commission subsystem (#5) and the Canadian Wheat Board subsystem (#6). Instruments introduced elsewhere in the Model which are controlled by subsystems 5 and 6 are summarized and combined with any newly selected instruments.

## The Canadian Grain Commission

### Function

The Canadian Grain Commission's objectives are defined in the Canada Grain Act as follows:

> Subject to the Act and any direction issued to the Commission from time to time under the Act by the Governor in Council or the Minister, the Commission shall, in the interests of the grain producers, establish and maintain standards of quality for Canadian grain and regulate grain handling in Canada to ensure a dependable commodity for domestic and export markets.[1]

To achieve these objectives, the Canadian Grain Commission (hereafter, the Commission) has been given extensive powers to:

A. Establish grain grades and standards and implement a system of grading and inspection for Canadian grain.
B. Establish and apply standards and procedures regulating handling, transportation and storage of grain and facilities used in such operations.
C. Conduct investigations and hold hearings when required.
D. Manage and operate government owned elevators which have been assigned to the Commission by the Governor in Council.

---

[1] C.H. Owen and D.G. Stephens, "Canadian Grain Commission," Grains and Oilseeds Handling, Marketing, and Processing, Book 1, A-2 (Winnipeg: Canadian International Grains Institute, 1975), p.4.

E. Undertake, sponsor and promote research in grain and grain products.
F. Advise the Minister as required on matters relating to grain or grain products.[1]

To carry out these powers, the Commission has authority to issue regulations or orders with respect to many functions. Functions pertaining to this study include the responsibility to:

1. Set maximum charges for services which may be made by...elevator operators;
2. Set fees payable for services provided by the Commission;
3. Recommend to the Governor in Council the addition or deletion of grain grades;
4. Supervise grain inspection and grading;
5. License elevators;
6. Approve construction plans for all elevators;
7. Compile and publish statistical information.[2]

The Commission is defined as having all of the above powers and responsibilities in subsystem #5 save the operation of government owned elevators. This function was included in the inland terminal and port terminal subsystems. For a review of the past role of the Commission in modernization of the system, see Pound.[3] This study assumes the Commission has one internal target -- its total realized cost of operation (RC5T). The one structural relationship defining RC5T is presented in Figure 8.1.

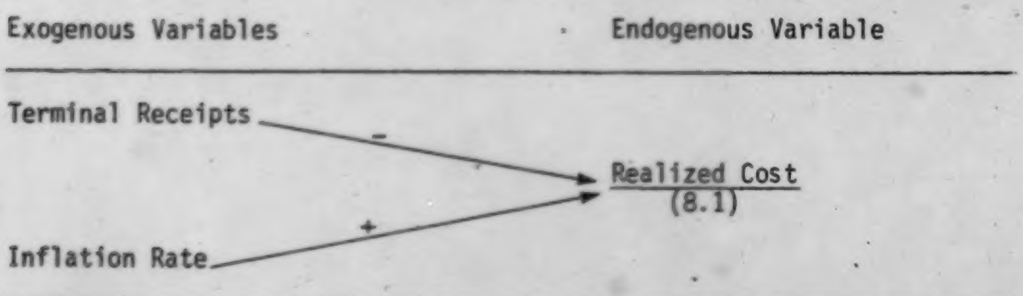
---

[1] Ibid., pp. 4-5.

[2] Ibid., pp. 5-6

[3] Pound, op. cit., pp. 1-15.

Figure 8.1: Logical relationships among variables endogenous and exogenous to Canadian Grain Commission (subsystem #5)



Structural Relationship

$$RC5T = f(\underset{-}{TR4}, \underset{+}{IR}) \tag{8.1}$$

where:

RC5T = Realized cost or deficit incurred annually by the Commission, in millions of dollars,

TR4 = Terminal receipts, in millions of bushels,

IR = Inflation rate, as an index.

Realized costs (RC5T) are a small contribution to total System realized costs yet are included in this study because the Commission's primary function is related to grain handling and transportation. RC5T is a deficit of the Commission as reported in Annual Reports submitted annually to Parliament through Agriculture Canada (who also pays the deficits). RC5T is defined to exclude the Canadian Government Elevator division of the Commission. Table 8.1 shows the total deficit (RC5T) over recent years.

A review of Commission annual reports indicates inspection and weighing divisions usually have revenues in excess of costs. Other divisions have comparatively little revenue. The revenues of inspection and weighing divisions vary as terminal receipts and shipments since a small tariff is received for weighing and inspecting each bushel. One

Table 8.1: Realized costs of operating the Canadian Grain Commission, 1971 to 1974

| Year | Realized Cost (millions of dollars) |
|---|---|
| 1971 | $2,148,858 |
| 1972 | 3,097,643 |
| 1973 | 6,832,905 |
| 1974 | 9,844,774 |

Source: Canadian Grain Commission (1971-1974), op. cit., and author's estimates.

measure of receipts and shipments, terminal receipts (TR4), is introduced to 8.1. Shipments vary closely as receipts so including both variables was unnecessary. Because the Commission tries to make a profit on inspection and weighing, their deficit will go down in years when terminal receipts are high; hence TR4 would have a negative coefficient in 8.1. Inflation will be a large factor in explaining the consistent rise in RC5T shown in Table 8.1; it is reflected by IR in statement 8.1. Since most Commission costs would be relatively fixed, statement 8.1 would have a large intercept when estimated by regression techniques.

## Policy Implications of Subsystem #5

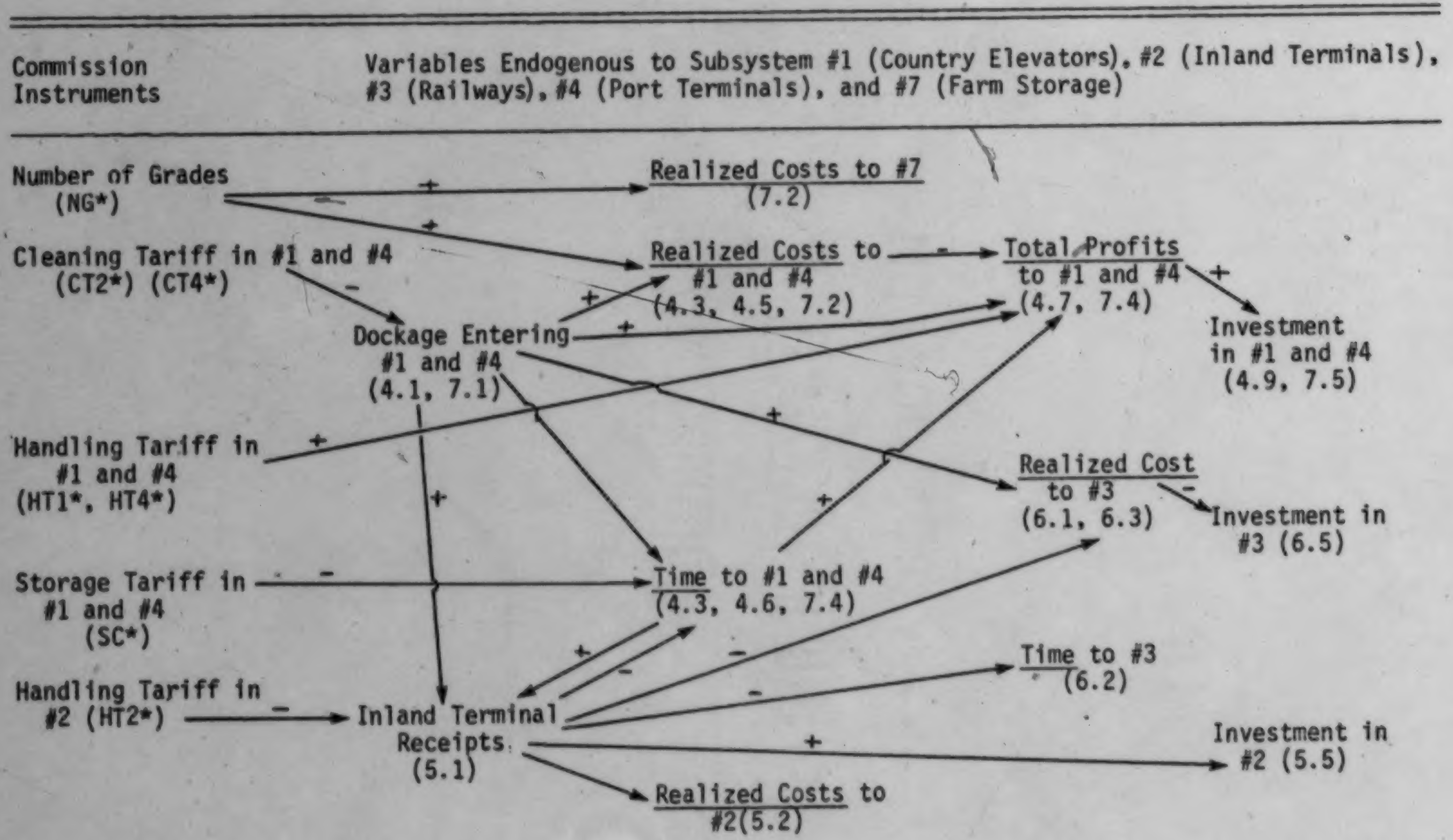
Instrument Selection -- The two exogenous variables introduced into 8.1, terminal receipts (TR4) and inflation, are rejected as instruments since neither are controllable. The coefficient of TR4 in any estimation of 8.1 represents, in part, the level of weighing and inspection tariffs. These tariffs are controllable by institutional changes within the Commission (see responsibility #2). These tariffs, while not a quantitative instrument in the technical sense for this Model, are annually adjustable by simple issuing of a Grain Commission order. Salaries negotiated for grain inspectors at terminals, other costing elements, and past tariff levels would be the primary decision making criteria in setting new tariff levels rather than any variability in TR4. Consequently, Statement 8.1 really has no policy implications but is merely a predicative statement.

Other Instruments -- Many of the instruments selected in elevator, inland terminal, and port subsystems are controlled by the Commission. The many linkages of these instruments to intended targets, and indirectly, to other endogenous variables were too complicated to analyze in detail in one diagram. To trace the detailed linkages, refer to the figures in sections or policy implications in other chapters. Figure 8.2 provides a conceptual overview of the effect of Commission instruments on two Model target variables -- cost and time. In Figure 8.2, elevator and port subsystem (#1 and #4) variables are lumped together for simplicity. The policy implications of the model as described in Figure 8.2 can be summarized as follows:

1. The Commission influences the System by setting the number of grades (NG*), cleaning tariffs (CT2*, CT4*), handling tariffs (HT1*, HT4*, HT2*), and storage tariff (SC*).

2. Should the System wish to reduce realized costs to elevator and port terminal subsystems, the Commission can choose between a) reducing the number of grades and b) reducing dockage flows through increases to cleaning tariffs.

Figure 8.2: Instrument-target linkages for instruments controlled by the Canadian Grain Commission


Commission Instruments
Variables Endogenous to Subsystem #1 (Country Elevators), #2 (Inland Terminals), #3 (Railways), #4 (Port Terminals), and #7 (Farm Storage)
Number of Grades (NG*)
Cleaning Tariff in #1 and #4 (CT2*) (CT4*)
Handling Tariff in #1 and #4 (HT1*, HT4*)
Storage Tariff in #1 and #4 (SC*)
Handling Tariff in #2 (HT2*)
Dockage Entering #1 and #4 (4.1, 7.1)
Inland Terminal Receipts (5.1)
Realized Costs to #7 (7.2)
Realized Costs to #1 and #4 (4.3, 4.5, 7.2)
Time to #1 and #4 (4.3, 4.6, 7.4)
Realized Costs to #2(5.2)
Total Profits to #1 and #4 (4.7, 7.4)
Realized Cost to #3 (6.1, 6.3)
Time to #3 (6.2)
Investment in #1 and #4 (4.9, 7.5)
Investment in #3 (6.5)
Investment in #2 (5.5)
+
-

3. To increase profits for elevator and port terminal subsystems, the Commission can choose between reducing costs (by the means outlined in 2 above) or increasing revenues by increasing handling tariffs. On balance, this author argued in Chapter II that the latter course, increasing handling tariffs, is most preferable as a means to improve profits and attract investment.

4. To reduce time in moving grain through elevator, port terminal, and railways subsystems, the Commission can choose between:

a) reducing dockage flows with high cleaning tariffs,
b) reducing storage tariffs as an incentive for throughput, or
c) encouraging greater inland terminal receipts by lowering handling tariffs at inland terminals.

The above examples verify the breadth of Commission freedom to steer the System with different instruments. By reading from left to right in Figure 8.2, the secondary or indirect effects of changing the level of an instrument can be traced. For example, reducing the number of grades (NG*) not only affects realized costs to elevators and port terminals but also reduces realized costs to the farm storage subsystem.

Tariff Structure -- The author wholeheartedly supports the thrust of the report of the Tariff Review Committee[1] which recommended that tariffs should:

---

[1] Canada Grain Commission, "Report of the Tariff Review Committee to the Canadian Grain Commission, "Winnipeg, Manitoba, 1974, pp. 6, 7, 10. (Mimeographed.) (Hereinafter referred to as 1974(a).

a. Be related to and be compensatory for services performed,

b. encourage required capital investment,

c. be deducted at the time of delivery and include as many of the per bushel charges as possible.

The Committee further recommended that the tariff structure should:

d. provide an incentive to perform required services,

e. not act as an artificial barrier to entry to the industry,

f. exercise looser tariff control whenever the Commission belives competitive forces are operating efficiently.

In general, the author feels the Commission's Implementation of these principles should emphasize looser tariff control (by setting higher maximum tariffs) so that the System can encourage new capital investment and use delivery incentives to provide spatial equity. The current 12 cent upper limit on handling tariffs at country elevators is a start; it is higher by 2.5 cents than the normal industry charge of 9.5 cents. Yet even this 12 cent limit should be increased to 13, 14, or 15 cents to encourage elevator points to set a higher tariff which would result in them having money to provide delivery incentives for those trucking over a minimal distance (say 10 miles). The impact of such delivery incentives were shown in subsystems 1 (DI1) and 2 (DI2); these incentives can cause economies to scale from high throughput at certain locations while maintaining some of the current spatial equity due to widely dispersed elevators. That is, fewer elevators at fewer points with high handling tariffs but paying delivery incentives can maintain equity (in the farm gate price) similar to that currently existing.

It follows that, in general, the author favors less short run emphasis on the price to the farmer (kept low by low tariffs) and more emphasis on high, loose tariff strategies which encourage adjustment and new investment. Investment can in turn, provide lower realized costs in the future by providing new labor saving elevator technology and higher throughput handling facilities. The effect of such a tariff strategy could be evaluated with this model if it were turned into a multi-year growth model (of, say, 5 years) where investment in one year would adjust the cost and profit levels in future years so that incentives could be paid and hence the price to the farmer kept low. The roles of the Commission must complement the function and instruments of the Canadian Wheat Board.

## The Canadian Wheat Board

### Function

As the sole marketing agency for export wheat, oats, and barley grown in Manitoba, Saskatchewan and Alberta, the Wheat Board attempts to market as much grain as possible at the best possible prices (to producers). Since its broad powers go beyond the scope of this study, only pertinent functions will be noted.[1]

The Canadian Wheat Board (hereafter called the Board) receives its authority from the Canadian Wheat Board Act, the Canada Grain Act, and various Orders in Council introduced over time. While substantially directed by the government through the Minister responsible for the Wheat Board, the costs for operating the Board are paid by farmers. To carry out its functions related to this study, the Board:[1]

---

[1] For a further description on Wheat Board functions, see: P.A. Suderman and D.G. Stephens, "The Canadian Wheat Board," Grains and Oilseeds Handling, Marketing and Processing, Book 1, A-3 (Winnipeg: Canadian International Grains Institute, 1973, pp. 1-14.

1. Issues delivery permits to farmers;
2. Sets initial prices that at the local farm levels include reductions for rail freight, elevator administration, and cleaning and handling tariffs;
3. Shares market among all farmers by setting non-cumulative delivery quotas;
4. Carries grain stocks in country elevators through payment of storage and interest charges to elevator firms;
5. Controls transportation of grain by rail;
6. Takes ownership of grain (by a warehouse receipt) from elevator companies as the grain enters port terminals;
7. Carries grain stocks in port terminals through payment of storage to port terminals and interest to banks;
8. Sells grain to export buyers (basis in-store port terminals) directly or through agents;
9. Pools the realized export prices for a year, deducts all costs and distributes from the pool a final payment to farmers for each bushel delivered.

The Wheat Board, for the purposes of this Model, is assumed to buy from the farmer and sell to the foreign buyer all grain as defined in Chapter III. Indicators chosen as targets for the Wheat Board subsystem are:

---

[1] Ibid., p. 5-15.

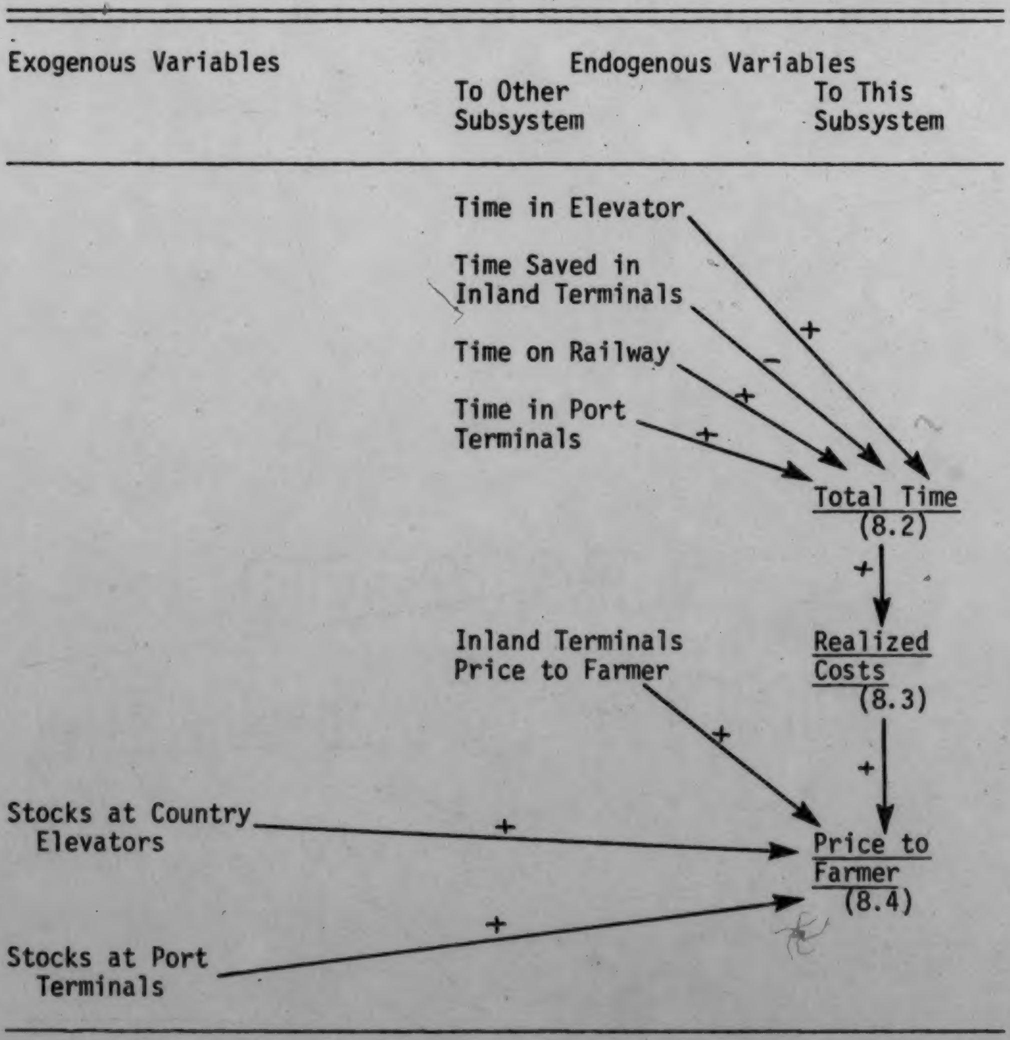
1. Total throughput time to move grain from the country elevator to the ship (TT6T).

2. Realized costs of marketing grain (RC6T).

3. Price reflected to the farmer of services under the management of the Board (PF6t).

Figure 8.3 shows the relationship of exogenous and endogenous factors described in this subsystem. Note the majority of the variables are endogenously determined in other subsystems of the Model. Limitations to this study did not enable the author to develop a testable statement reflecting storage stocks so they are introduced exogenously to 8.4.

Figure 8.3: Logical relationships among variables endogenous and exogenous to Canadian Wheat Board subsystem (#6)


Exogenous Variables
Endogenous Variables
To Other Subsystem
To This Subsystem
Time in Elevator
Time Saved in Inland Terminals
Time on Railway
Time in Port Terminals
+
−
+
+
Total Time (8.2)
+
Realized Costs (8.3)
Inland Terminals Price to Farmer
+
+
Stocks at Country Elevators
+
Price to Farmer (8.4)
Stocks at Port Terminals
+

Time

$$TT6T = (TM1T - w_1) - TM2 + k(TM3T) + TM4T \qquad 8.2$$

where:

TT6T = Total time to the Wheat Board that a bushel takes to go through country elevators, inland terminals, railways and port terminals,

$(TM1T - w_1)$ = Time in country elevators paid in storage by the Wheat Board where $(w_1)$ is the free period, in days,

TM2 = Time, in days, removed from the normal time to forward grain by using inland terminals,

K(TM3T) = Time, in days, that grain is on rail cars where k = proportion of days cars are full and

TM3T = time for the rail cay cycle, in days,

TM4T = Time in port terminal subsystem, in days.

Statement 8.2a is an accounting expression defining the cumulative days (TT6T) required to move grain through subsystems 1 and 4. TT6T is important since, as the level of TT6T increases, the storage and interest carrying charges paid by the Wheat Board increase. The first variable in 8.2, TM1T, was defined in 4.6. The Wheat Board does not pay carrying charges on the first few days grain is in the elevator; this "free period" $(w_1)$ is currently set at ten days. TM2 was defined in 5.3 as the time saved per bushel from the normal elevator-to-port rail car cycle because of using inland terminals. This time saving is therefore introduced with a negative sign. From Figure 6.2, rail cars were loaded with grain approximately 14.9 days, or 83 percent, of the car cycle (TM3T). In that year, therefore, k = .83 and 0.83 (TM3T) gives the time grain was in the railway subsystem. Time in terminals (TM4T) was explained in statement 7.3.

Realized Cost

$$RC6T = f\,(\underset{+}{TT6T})$$

where:

$RC6T$ = Realized costs for marketing grain as paid by the Wheat Board, in cents per bushel.

Realized costs are a narrowly defined portion of operating costs reported by the Wheat Board. Costs of operating the wheat pool are taken as an indicative measure of RC6T for all grains. As summarized in Table 8.2, realized costs include those costs not otherwise incurred and explained already in other subsystem. Demurrage, interest on stocks, and administration of the Board itself make up RC6T which varied from a low of 2.14 cents in 1972/73 to a high of 6.55 cents in 1973/74. Both demurrage and interest are directly related to time so it was felt logical to explain the variation of all realized costs with time (TT6T). The constant in any regression estimate of 8.3 would be large since administration will not change with TT6T.

Price to the Farmer

$$PF6T = w_2(ST2 + ST4) + (IT2)\,(PF2)/TR4 + RC6T \qquad 8.4$$

where:

$PF6T$ = Price paid by the farmer per bushel through the Board for Board realized costs plus storage, interest, and other expenses

$W_2(ST2 + ST4)$ = Storage cost, in dollars per bushel

where:

$(ST2)$ = Normal stocks at country elevator, in millions of bushels,

$(ST4)$ = Normal stocks at port terminals, in millions of bushels

$w_2$ = Parameter convering stocks to dollars per bushel,
$= \frac{365(SC)}{TR4}$ where SC = storage charge in cents per bushel per day,

(IT2) (PF2)/(TR4) = Price to the farmer for using inland terminals, per bushel received at terminals where:

IT2 = Inland terminal receipts, in millions of bushels,

TR4 = Port terminal receipts, in millions of bushels,

PF2 = Price to farmer for each bushel going through an inland terminal.

The level of PF6T over recent years is shown in Table 8.2. In addition to the Board's own realized costs, the Board pays out inland terminal charges and storage at country elevators and port terminals. PF6T has varied from 10.62 cents per bushel in 1971/72 to 16.7 cents per bushel in 1973/74. The largest variation in charges to the pool account for wheat is due to changes in the use of inland terminals and carrying charges at country elevators.

Statement 8.4 is simply an accounting expression adding the Board's realized costs to the price of using inland terminals (from statement 5.4) and the cost of carrying storage stocks. Inland terminals are only used for a proportion of total bushels going to port. IT2/TR4 is therefore introduced to average the per bushel inland terminal price (PF2T) among all bushels going to port. The annual storage cost (365(SC)) is multiplied by the stock levels at country elevators (ST2) and port terminals (ST4) to get the total storage bill. This storage bill is then averaged over the total throughput by dividing by TR4. Hence, per bushel storage cost = 365(SC) (ST2 + ST4)/(TR4).

Table 8.2: Receipts, realized cost, and price to farmers in operation of the Pool Account for wheat, 1971/72 to 1974/75

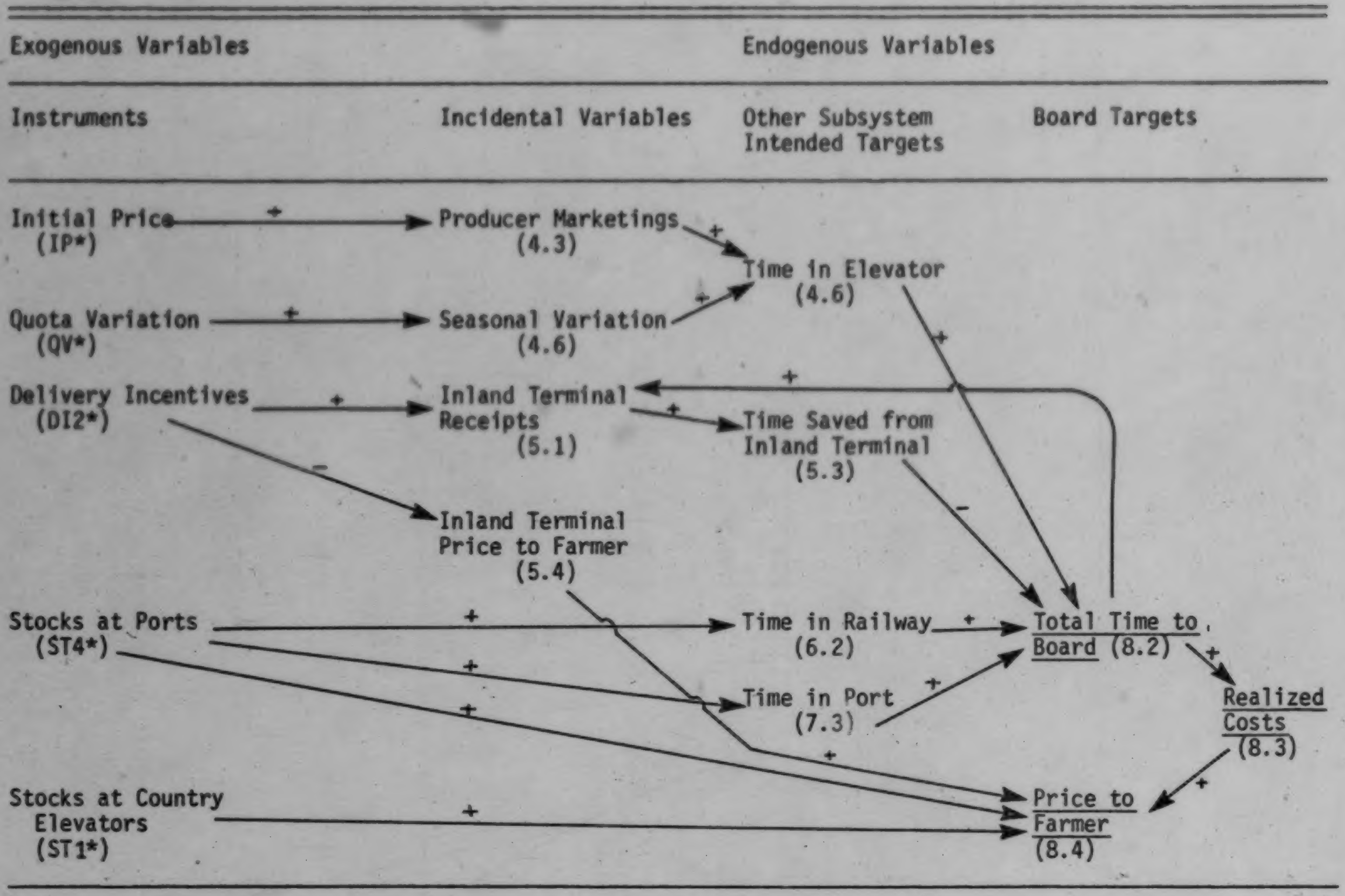
| Item | Year 1971-72 | 1972-73 | 1973-74 | 1974-75 |
|---|---|---|---|---|
| | - millions of bushels - | | | |
| Terminal Receipts from Producers | 511 | 554.6 | 612.2 | 405.8 |
| | - cents/bushel - | | | |
| Realized Costs | | | | |
| interest | 1.50 | 1.00 | 3.24 | 2.66 |
| administration | 1.06 | 1.14 | 1.17 | 2.03 |
| demurrage | N/A | N/A | 2.14 | .83 |
| Total Realized Costs | 2.56 | 2.14 | 6.55 | 5.52 |
| Other Charges to Pool | | | | |
| inland terminal charges | .33 | .72 | 1.11 | 1.19 |
| trucking payments and drying carrying charges at country elevators | 5.72 | 4.50 | 7.14 | 5.34 |
| storage at terminal | 2.01 | 1.85 | 1.91 | 1.98 |
| Total Price to Farmers | 10.62 | 9.21 | 16.7 | 15.03 |

Source: Canadian Wheat Board, Annual Report (Winnipeg: CWB, 1971/72, 1972/73, 1973/74, 1974/75) and author's estimates.

## Policy Implications

Instrument Selection -- Figure 8.4 first shows the linkages of four instrument variables already selected for other subsystems and then the linkage of one new variable, stocks in country elevators (ST2*). The other four instruments (initial price, quota variation, delivery

Figure 8.4: Instrument-target linkages affecting variables endogenous to Canadian Wheat Board (Subsystem #6)


Exogenous Variables
Endogenous Variables
Instruments
Incidental Variables
Other Subsystem Intended Targets
Board Targets
Initial Price (IP*)
Producer Marketings (4.3)
Time in Elevator (4.6)
Quota Variation (QV*)
Seasonal Variation (4.6)
Delivery Incentives (DI2*)
Inland Terminal Receipts (5.1)
Time Saved from Inland Terminal (5.3)
Inland Terminal Price to Farmer (5.4)
Stocks at Ports (ST4*)
Time in Railway (6.2)
Total Time to Board (8.2)
Time in Port (7.3)
Realized Costs (8.3)
Stocks at Country Elevators (ST1*)
Price to Farmer (8.4)
+
−

incentives, and stocks at ports) may have enough effect through the time target (TT6T) to reduce PF6T to target levels. Judgement on the sufficiency of their effect depends on the level of coefficients whose estimation is left to another study.

That reducing stock levels (ST2*) can effectively reduce PF6T is shown by the direct accounting calculation of 8.4. The Board has noted[1] how reducing ST2* substantially affects PF6T. The selection of ST2* was also based on the fact that carrying charges at country elevators are continually the largest cost item in the pool account for wheat (see Table 8.2). Reducing ST2* is now more politically acceptable since programs for cash advances, postponement of income (for tax purposes), and grain stabilization remove a portion of the pressure by farmers to move grain into commercial position for payment. Since storage charges in elevators approximate 12.1 cents per year (at 1/30 cents per day) compared to 6.0 cents per year on the farm (see Table 3.2), reductions of ST2* could bring a reduction in the price paid by farmers in excess of 5 cents per year.

Table 8.3 identifies the author's assessment of side effects which are, on balance, neutral. Note the positive benefits of less ST2* are largely within the system while negative effects are outside the system. Negative effects of lower stock levels include reduced elevator investment and small town activity, and reduced income stability between years. Perhaps a larger-than-average burden will also be placed on farmers who are small or are located in newly developed areas, and therefore need off-farm storage. The author judges, however, that the

---

[1] Canadian Wheat Board, 1974-75, op. cit., p. 54.

Table 8.3: Side effects of new instruments selected for Canadian Wheat Board (Subsystem #6)

| Instrument | | Reduce Stocks in Country Elevators |
|---|---|---|
| Intended Target | | Price to Farmer |
| Investment - this system | | 0 |
| Investment - by others | | - |
| Rural Development | | - |
| Competition | | + |
| Income Stability | | - |
| Income Distribution | | - |
| Spatial Equity | | - |
| Grain Quality | | + |
| Range and Quality of Services | | 0 |
| Safety | | 0 |
| Less Pollution and Energy Consumption | | 0 |
| Labor Productivity | | + |
| Freedom to Allocate Resources | | + |
| Grain Handling Coordination | | + |
| Livestock Production | | 0 |
| Totals | + | +5 |
| | - | -5 |
| | net | 0 |

direct positive effect of reductions in price (PF6T) would outweigh indirect negative distributional factors. In addition, the negative side effects in Table 8.3 are substantially covered by programs like cash advances.

Other considerations regarding quantitative instruments include:

1. Grain Reserves. Any introduction of a policy to maintain food reserves in commercial position would increase PF6T. Since such reserves are for humanitarian reasons and are best financed by the Canadian public at large, the author feel such increases in stocks should be equally balance by storage subsidies to the Board to cover costs. Such an eventuality could be introduced by adding a grain reserve variable (GR) to the right hand side of 8.4 and a countervailing subsidy variable (say SV) to the left hand side of 8.4. A detailed assessment of the rationale and costs of food reserves is left to another study.

2. Delivery Incentives. The steering trade-offs at stake in introducing delivery incentives (DI2*) are clearly shown in Figure 8.4 by working from right to left. To reduce realized costs and thereby total time (8.3, 8.2), policy-makers would call for additional terminal receipts that in turn require delivery incentives to cause grain to be diverted to inland terminals (5.1). The trade-off loop is completed by (5.4) and (8.4); that is, delivery incentives push up the price of moving grain to port. Policymakers would gain guidance on when to use inland terminals for surge movement by comparing the savings in realized cost (shown by the coefficient of (TTMT) in 8.3) to the price of using inland terminals (PF2). The savings in realized costs (RC6T) by using inland terminals plus any windfall gains in the export price as a result of

timely delivery should exceed or equal the price of using inland terminals (PF2).

3. Free Storage Period. Increasing the free period ($w_1$) at the country elevator would reduce the cost of elevator time (TM2T) to the Board. That is, by merely increasing the free period by several days, the Board would reduce its interest and storage payments. However, ($w_1$) was rejected as an instrument because increasing ($w_1$) breaks the principle that the user (the Board) should pay the provider of the service (the elevator company). In addition, a greater free period would just be transferred to a higher handling tariff (HT2*) charged to farmers.

## Summary

This chapter introduced four statements to explain the target variables selected for the Canadian Grain Commission and Canadian Wheat Board. One new instrument, country elevator stocks, was assessed as it affects the price to the farmer. Nine instruments introduced elsewhere in the Model are controlled by the Commission or Board. The trade-offs among these nine instruments were discussed. Three policy changes were advocated: a looser handling tariff structure, subsidies for any storage of food reserves, and increased use (as a steering instrument) of delivery incentives to inland terminals.

# CHAPTER IX

# FARM STORAGE AND TRUCKING SUBSYSTEMS

## Introduction

Functions for both storage and trucking are controlled by the individual choices of permit holders. Of all the subsystems, these are the most dispersed and uncontrollable subsystems. Subsystem functions include:

1. Farm Storage: To hold grain in separate bins or storage spaces (according to kinds and grades of grain) at positions accessible to rural roads in such a way that shrinkage or spoilage and other losses of grain are minimized. The functions of grain loading are also included in this subsystem. Farm cleaning and drying are left to another study.

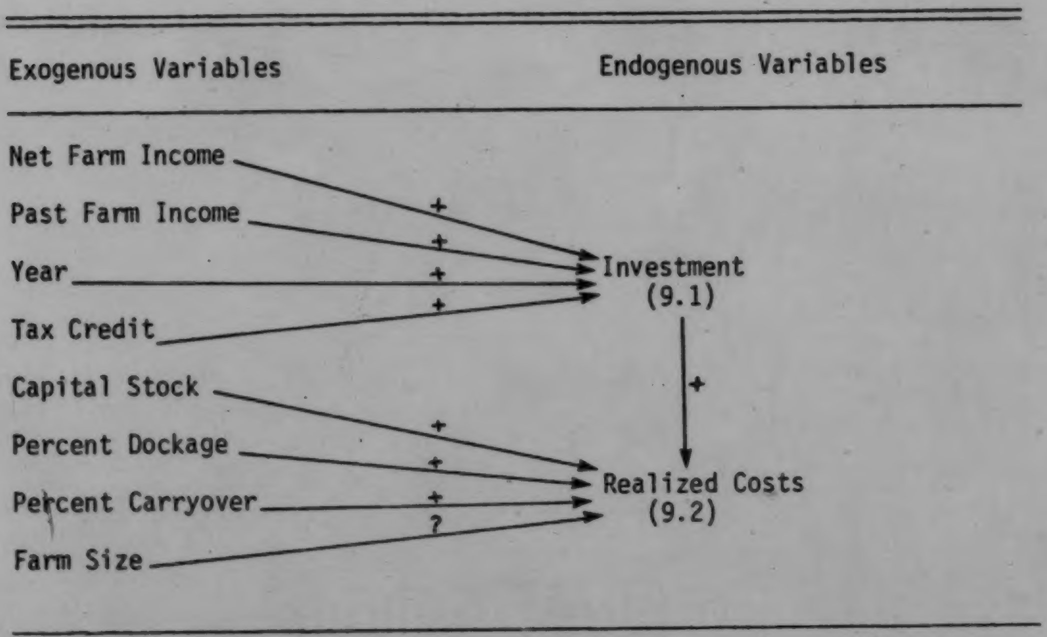
2. Trucking: To move grain from farm storage to country elevators or inland terminals in the time desired and at the lowest cost. While trucks perform other functions on the farm, only the time and costs associated with grain marketing are considered in this model. A detailed discussion of the costs of transporting grain by commercial trucks is left to another study.

## Farm Storage

### Targets

Only one target is selected: realized cost of farm storage per bushel (RC7T). A vital side effect to be examined is investment in farm storage, in millions of dollars (IN7S). The linkages between variables are described in Figure 9.1.

Figure 9.1: Logical relationship among variables endogenous and exogenous to farm storage subsystem (#7)


Exogenous Variables
Endogenous Variables
Net Farm Income
Past Farm Income
Year
Tax Credit
Capital Stock
Percent Dockage
Percent Carryover
Farm Size
+
+
+
+
Investment (9.1)
+
+
+
+
?
Realized Costs (9.2)

Investment

$$IN7S = f\,(\underset{+}{(NF7 + TC7)}\ \underset{+}{NF71},\ \underset{+}{YR}) \qquad 9.1$$

where:

IN7S = Investment in farm storage and handling facilities, per year, in millions of dollars,

NF7 = Net farm income from grain on the Prairies, in millions of dollars,

TC7 = Tax credit, in millions of dollars,

NF71 = Net farm income in the previous year from grain, in millions of dollars, for the Prairies,

YR = Year where 1956 = 1, 1957 = 2, etc.

Statement 9.1 is based on the basic investment model 2.10 with net farm income (NF7) plus any tax credit (TC7) substituted for cash available to invest ((E) in 2.10). A model for a broader definition of investment (for all farm structures) was estimated by

Denton, et al.[1] Their model included three explanatory variables for investment (I): current net farm income (Y, on a national accounts basis), previous net farm income ($Y_{t-1}$), plus the year (YR). Their study showed significant investment responsiveness to changes in both current and past income. As shown by Table 9.1, farmers in Alberta spend $77 over two years with an increase of $1,000 in income. Saskatchewan farmers respond least of farmers in the Prairie Provinces with only $28 in investment.

Table 9.1: Expected increases in investment in repair and new construction associated with a hypothetical increase of $1,000 in farm net income, by province

| Province | Expected increase in investment expenditure in: The year in which income increases | The following year | Both years combined |
|---|---|---|---|
| | | - dollars - | |
| Alberta | 28 | 49 | 77 |
| Saskatchewan | 19 | 9 | 28 |
| Manitoba | 30 | 27 | 57 |

Source: Denton, et al., op. cit., pp. 28-29

Denton's work proves, in the author's view, the sign and significance of NF7 and NF71. Since tax credits (TC) are another form of income, TC would have a similar positive coefficient to NF in 9.1. Denton used the time trend variable (YR) to signify long term trends like technology and increases in credit extended.

---

[1] Denton, et al., op. cit., pp. 26-29

If during estimation farm storage investment (IN7S) and grain net farm income, for the Prairies (NF) cannot be quantified, the author proposes to substitute one of Denton's provincial models (say for Manitoba) for 9.1. Results from Denton's model, for investment (I) in all farm structures would, on a post hoc basis, be multiplied by the proportion (k) of farm capital stock that is farm storage. That is IN7S = k(I) where (I) is obtained by substituting Denton's model for 9.1.

Certain other variables or specifications were rejected. Capital stock was rejected due to measurement difficulty. Any indirect effects on farm storage investment from reduced elevator capacity was judged to be very local in nature and is diffused by lags as compared to income as a determinant. Intuitively, farm storage investment would grow with a long term drop in stocks at ports (ST4) or elevators (ST2). However, stocks were rejected from 9.1 because their effect is also very diffuse and lagged compared to income and the general time trend variable (YR).

Realized Cost

$$RC7T = f\left(\left(\underset{+}{CS71 + s(IN7S)}\right), \underset{+}{DE1/PM1}, \underset{+}{PC7}, \underset{?}{FS}, \underset{+}{NG}\right) \qquad 9.2$$

where:

RC7T = Realized costs per bushel for farm storage and grain handling,

(CS71 + s(IN7S) = Capital stock, in dollars per acre
where CS71 = capital stock in farm storage in the previous year, in dollars per acre,
s = 1/number of acres on Prairies,

(DE1)/(PM1) = Percent dockage where
DE1 = dockage entering country elevators, in millions of bushels,
PM1 = producer marketings to country elevators, in millions of bushels,

PC7 = Percent carryover (carryover stocks/annual production),

FS = Average farm size, in hundred of acres,

NG = Number of grades.

Statement 9.2 could be estimated from a cross-sectional survey of farmers similar to that in the only study of farm storage costs currently available. This study was carried out by Friesen[1] in conjunction with Grains Group activities in 1969/70. Because of the lack of background research, 9.2 is very crude. It draws one variable from Friesen - that costs vary with the size of farm (FS). Friesen[2] indicates costs decrease with increasing farm size up to 1,280 acres per farm; thereafter costs increase with increasing farm size. Hence, no conclusions are drawn on the sign of the coefficient of FS except that estimation of 9.2 would use a quadratic functional form.

Other variables in 9.2 are based on these premises:

1. That the fixed element of per bushel costs will rise as the value of farm storage facilities (CS71 + s (IN7S));

2. That variable costs of insurance, bin repair, and spoilage will increase as the proportion carried over from year to year (PC7);

3. That costs increase in proportion to the bulk and spoilage implications of the percent of dockage (DE1/PM1);

4. That as the number of kinds of grain on a

---

[1] B.A. Friesen, "Farm Stored Grain on the Prairies" quoted in Canada Grains Council, 1973a, *op. cit.*, p. 78-84.

[2] *Ibid.*, p. 80.

farm increase, the number and technology of bins must increase and hence, costs. The number of grades (NG) is introduced as a proxy measure from other subsystems to reflect this relationship.

Current investment (IN7S) is added to capital stock since, from the author's farm experience, most investment in a calendar year is made in the spring and summer, prior to the crop year. Hence, new bins immediately reflect in storage costs of grain harvested. Variables rejected from 9.2 because of measurement difficulty include the age, type, and size of bin.[1] By contrast, variables in 9.2 could be estimated annually for an average farm and quickly plugged into statement 9.2. Subject to the crude format of 9.1 and 9.2, the policy implications are now assessed.

Policy Implications

Figure 9.2 shows the target-instrument linkages affecting this subsystem. Only one new variable, tax credits for new storage investment (TC7), was judged controllable as an instrument (TC7*) whose increase will increase investment. The persistent use of TC7* by Revenue Canada in the late sixties and early seventies to encourage investment in farm drying, storage, or cleaning facilities suggests they deemed the instrument effective. The instrument has the additional advantage of no negative side effects and eight positive effects as shown in Table 9.2.

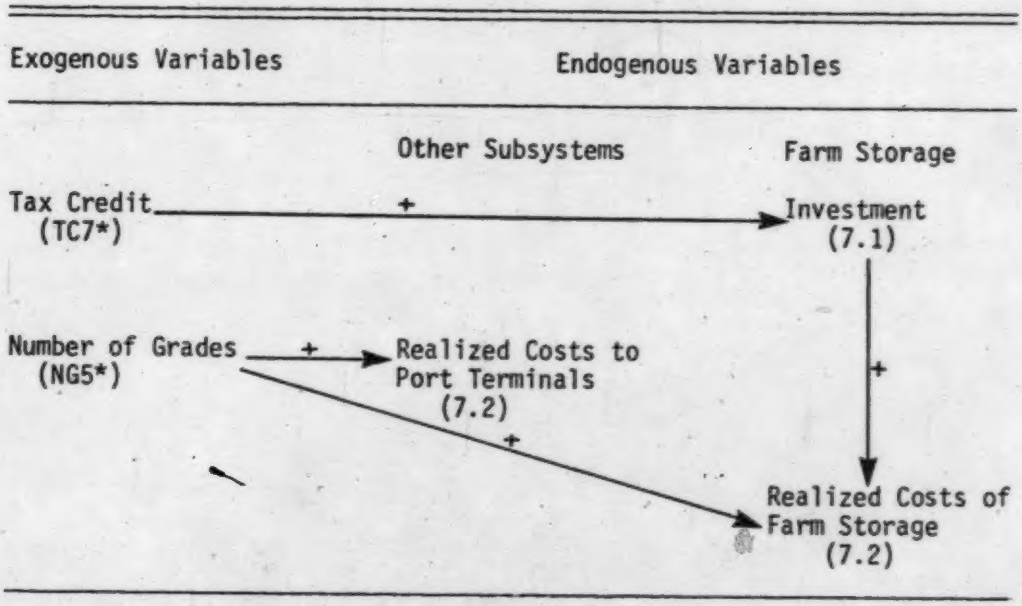
---

[1] Friesen's descriptive exercise found these variables influential (Ibid., p. 80.)

Table 9.2: Side effects of instruments selected for farm storage subsystem (#7)

| Instrument | Increase Tax Credit | Reduce Number of Grades |
|---|---|---|
| Target | Investment | Cost |
| Investment - This System | + | - |
| Investment - by Others | 0 | - |
| Rural Development | + | 0 |
| Competition | 0 | + |
| Income Stability | + | + |
| Income Distribution | 0 | - |
| Spatial Equity | 0 | + |
| Grain Quality | + | - |
| Range and Quality of Services | + | - |
| Safety | + | 0 |
| Air Quality and Energy Consumption | 0 | 0 |
| Labor Productivity | + | - |
| Freedom to Allocate Resources | 0 | + |
| Grain Handling Coordination | + | + |
| Livestock Production | 0 | + |
| Totals + | 8 | 5 |
| - | 0 | 6 |
| net | +8 | -1 |

Figure 9.2: Instrument-target linkages affecting farm storage subsystem (#7)


Exogenous Variables
Endogenous Variables
Other Subsystems
Farm Storage
Tax Credit (TC7*)
+
Investment (7.1)
Number of Grades (NG5*)
+
Realized Costs to Port Terminals (7.2)
+
+
Realized Costs of Farm Storage (7.2)

The only variable controllable in statement 9.2 is the number of grades (NG*). Reductions in NG were also selected for the elevator and port subsystems; side effects reported in subsystem 1 are repeated in Figure 9.1 and are, on balance, negative. NG* would have a very weak influence on costs because bins are commonly small (near 2,000 bushels) and quite divisible. Therefore more grades will not result in much bin space being partially empty. Secondly, working space is not an important factor affecting costs since farm bins are only filled once per year. No matter how many kinds of grades of grain, by the time a farmer wishes to refill bins for seed or turning grain, at least one or two bins are available.

A great deal of additonal research is needed to point out the important technology, cost, and policy factors affecting farm storage. The excessive preoccupation of public debate with elevator storage space and cost is understandable yet the lack of focus on farm grain handling may be costing millions. Several factors requiring study include:

1. What is the effect on Canadian investment and costs of farm drying or cleaning when a) elevator cleaning tariffs change or b) when the elevator system fails to have the money and organization to place cleaners and dryers at country points? Hill[1] found that farm investment in the United States increases if cleaning tariffs at the elevator go up.

2. What is the total economic cost of dispersing many small dryers on Prairie farms? While farmers gain flexibility and harvest capability with a dryer, Peace Agra[2] suggests total costs are greater than if farmers invested in a few crop handling stations with dryers. The author suggests farmers may have won one battle against inflation by insisting on many small elevators with low handling tariffs yet no money to buy dryers. Meanwhile farmers have lost possibilities of long run least cost handling and drying by transferring drying technology to the farm at high per bushel costs. For a review of the arguments on this, see the Peace Agra proposal.[3]

Elements of the trucking subsystem are analyzed next.

---

[1] Lowell D. Hill, "Economic Determinants of the Farm and Elevator Trends in the Volume of Corn Artificially Dried," American Journal of Agricultural Economics, Vol. 52, No. 4 (November 1970), pp. 563-568.

[2] Peace Agra Cooperative Ltd., op. cit., pp. 14-16.

[3] Ibid., p. 12-55.

## Trucking Subsystem

The following two targets are selected for subsystem 8 (farm trucking):

1. Realized cost to farmers for trucking in dollars per bushel (RC8T).

2. Time between quota announcement and farm delivery (TM8T), in days.

Side effects of importance to subsystem stakeholders are investment (IN8S) and the global extra cost of trucking due to rail line abandonment and inland terminals (NE8). The structural relationships described next are shown in Figure 9.3.

Realized Costs

$$RC8T = f(NE, (PM1/FM), IR) \qquad 9.3$$

where:

RC8T = Realized cost to the farmers per bushel,

NE = Number of elevator units,

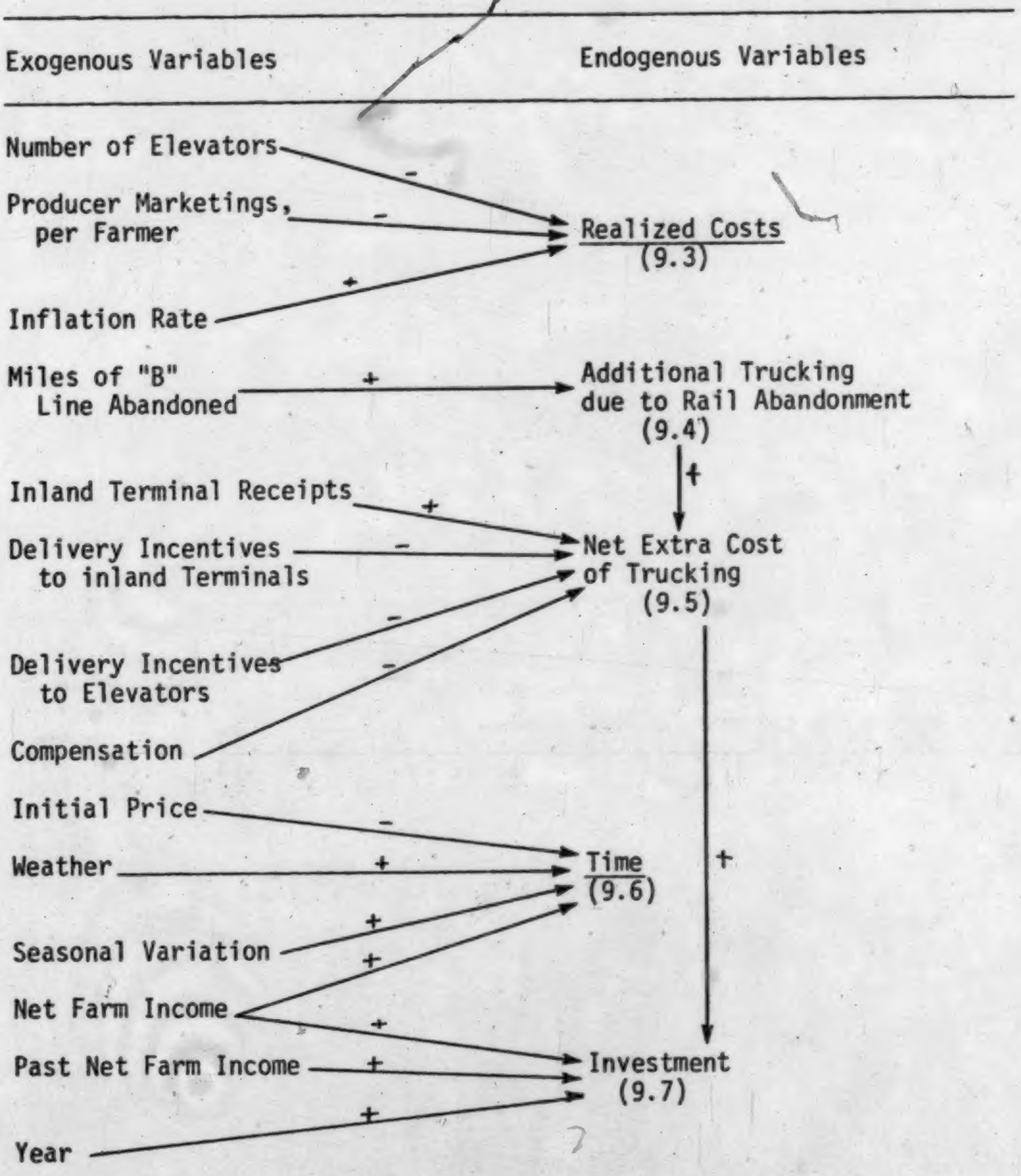
PM1/FM = Producer marketings per farm, in thousands of bushels, where FM = number of permit holders, PM1 = Producer marketings, in thousands of bushels

Statement 9.3 is the final stage of three logical steps to incorporate per bushel trucking costs into this policy model. The first step (statement 9.3a) identifies that a measure of truck use, total bushel-miles, is the key factor of farm costs. Statement 9.3a is taken from the Canada Grains Council Area Eleven study.[1]

---

[1] Canada Grains Council (1975a), *op. cit.*, p. 34.

Figure 9.3: Logical relationship among variables endogenous and exogenous to trucking subsystem (#7)


Exogenous Variables
Endogenous Variables
Number of Elevators
-
Producer Marketings, per Farmer
-
Inflation Rate
+
Realized Costs (9.3)
Miles of "B" Line Abandoned
+
Additional Trucking due to Rail Abandonment (9.4)
+
Inland Terminal Receipts
+
Delivery Incentives to inland Terminals
-
Delivery Incentives to Elevators
-
Compensation
-
Net Extra Cost of Trucking (9.5)
Initial Price
-
Weather
+
Seasonal Variation
+
Net Farm Income
+
+
Time (9.6)
+
Past Net Farm Income
+
Year
+
Investment (9.7)

log. average total cost per bushel-mile = 1.45494-

0.32078 log. bushel-miles. 9.3a

While 9.3a does not reflect all the variables known to affect cost,[1] it yields "the closest approximation possible of the costs of farm trucking given the information available."[2] Statement 9.3a was estimated from cross-sectional data of actual farm data updated for inflation to 1974. Logarithmic specification indicates costs are curvilinear with truck use; hence, marginal costs of one extra mile or one extra bushel decreases as total truck use (in bushel-miles) increases.

Following the Grains Council logic,[3] average cost per bushel-mile is calculated by substituting distance and bushels into 9.3a as shown in 9.3b

$$\log ATC/BM = 1.45494 - 0.32078 \log ((DH)(AH8)) \qquad 9.3b$$

where:

ATC/BM = Average total cost per bushel-mile,

DH = Distance of haul to elevator, in miles,

AH8 = Amount hauled to elevator, in bushels.

That is, provided the distance to the elevator and total amount hauled in a year are known, the utilization (in bushel-miles) of a truck can be calculated by multiplying (DH) (AH8). Hence, through 9.3b, the average per bushel-mile cost is calculated. The third step as shown in 9.3c involves multiplication by distance to give the average cost per bushel of hauling grain to the elevator by farm truck (AC).

---

[1] For a summary of the extensive research on farm trucking see: Canada Grains Council (1975b), op. cit., pp. 5-11. The relationship among factors affecting the average cost per bushel-mile is summarized in that study on page 6 as follows:

1. As size of the truck increases, average cost per bushel-mile decreases.
2. As trucks increase in age, they tend to have lower total grain transportation costs, transport fewer bushels of grain, travel a shorter distance to the elevator and have a slightly higher cost per bushel-mile.
3. As distance to the elevator increases, average cost per bushel-mile decreases while the size of the truck increases.
4. As the volume of grain delivered increases, average cost per bushel-mile decreases.

[2] Canada Grains Council (1975a), op. cit., p. 43.

[3] Ibid , pp. 47-53.

$$AC = (DH)\ (ATC/BM) \qquad 9.3c$$

Results derived by the Grains Council for different distances and amount hauled are shown in Table 9.3.

Table 9.3: Average cost of hauling grain to elevators by farm truck in cents per bushel, 1974

| Distance to Elevator (in Miles) | Cents per Bushel | | | | | |
|---|---|---|---|---|---|---|
| 48 | 41.3 | 24.6 | 19.7 | 17.3 | 14.7 | 13.2 |
| 35 | 34.8 | 20.8 | 16.6 | 14.6 | 12.4 | 11.1 |
| 25 | 27.7 | 16.5 | 13.2 | 11.6 | 9.8 | 8.9 |
| 15 | 19.6 | 11.7 | 9.3 | 8.2 | 7.0 | 6.3 |
| 10 | 14.8 | 8.9 | 7.1 | 6.2 | 5.3 | 4.8 |
| 5 | 9.3 | 5.5 | 4.4 | 3.9 | 3.3 | 2.8 |
| 1 | 3.1 | 1.8 | 1.5 | 1.3 | 1.1 | 1.0 |
| | 1 | 5 | 10 | 15 | 25 | 35 |

Amount Hauled to Elevators
(thousands of bushels)

Source: Canada Grains Council, Information Booklet, Area 13 (Winnipeg: Canada Grains Council, 1975), p. 96.

Table 9.3 demonstrates the effect of farm size (amount hauled) on cost: a small farmer hauling only 5,000 bushels for 10 miles incurs a cost of 8.9 cents per bushel while a larger farmer hauling 35,000 bushels incurs only a 4.8 cent cost for 10 miles and can go to 25 miles before his costs become 8.9 cents per bushel.

The final step toward integrating 9.3a into this policy model is to substitute variables endogenously determined by other subsystems of the Model into 9.3c. The logic is as follows:

1. Define AC = RC8T.

2. Calculate the average amount of producer haul in a year from total producer marketings (PM1) divided by the number of farmers (FM);

i.e., AH8 = PM1/FM

3. In a general way, one expects the distance of haul to increase as the number of elevator points decreases. This relationship has been shown mathematically by Beckman.[1] The distance of haul (DH) is currently estimable for given locations by using the PHAER simulation program at the Canadian Transport Commission.[2] The Statement (DH = g (number of points)) is estimable if "g" conceptually represents the PHAER simulation program. In this conceptual model, we assume the

---

[1] Martin Beckman, Location Theory (New York: Random House, 1968), Chapter 5.

[2] For an example of these estimates, see the estimates for the Stettler subdivision in: Canadian Transport Commission, Prairie Grain Handling and Transportation Background Data, Area 15, Stettler subdivision (Ottawa: Queen's Printer, 1975), Table 1.

number of elevator units is a proxy for elevator points (NE). Hence, DH = g (NE).

4. Substituting the above assumptions into 9.3b gives

$$\log ATC/BM = 1.45494 - 0.32078 \log ((PM1/FM)\ (g(NE))) \qquad 9.3d$$

which by 9.3c becomes

$$RC8 = \text{Antilog}\ (1.45494-0.32078 \log (PM1/FM)\ (g(NE)) \qquad 9.3e$$

5. Conceptually, 9.3c is represented as

$$RC8T = f\ (PM1/FM,\ NE) \qquad 9.3f$$

Since costs will increase with inflation, an index of inflation is added to 9.3f to update costs, conceptually, for future years, Hence:

$$RC8T = f\ (\underset{-}{PM1/FM},\ \underset{-}{NE},\ \underset{+}{IR}) \qquad 9.3$$

In summary, costs increase as the number of elevators decrease, the average producer marketings decrease, and the inflation rate increases.

Reflection of commercial trucking costs and rates in this Model was omitted to simplify the number of statements. Were it necessary to introduce a statement, the Grains Council has estimated statements similar to 9.3a showing custom rates per hundredweight as a function of distance.[1]

Additional Trucking

$$AT8 = f\ (MB) \qquad 9.4$$

where:

AT8 = Additional Trucking, in thousands of bushel-miles, as a result of branchline abandonment.

MB = Miles of "B" category line abandoned.

---

[1] Canada Grains Council (1975a), op. cit., pp. 58-61

Statement 9.4 is a conceptual presentation of the following accounting statement:

$$AT8 = \sum_{i=1}^{n} (MB_i)\ (BU/MI)_i\ (ED_i) \qquad 9.4a$$

where:

$i = 1....n$ = Number of "B" category subdivisions abandoned,

$MB_i$ = Length in miles of the $i^{th}$ "B" category subdivision abandoned,

$(BU/MI)_i$ = Bushels per mile of track, in thousands of bushels, for the $i^{th}$ branchline,

$(ED_i)$ = Extra distance for trucking, if the subdivision is abandoned.

Additional trucking (AT8) is of interest to highways officials and farm policy makers; 9.4 shows the effect for them of decisions on abandonment. Each of the above variables is easily taken for each subdivison from materials generally available from the Wheat Pools.[1] Bushels per mile of track (BU/MI) is an indicator of the traffic density generally utilized in briefs to the Hall Commission.[2] ED is an indicator of the extra truck haul necessary if a subdivision is abandoned. Since $BU/MI_i$ and $ED_i$ are known and relatively constant over time for each subdivision, the only variable in 9.4a is actual lines abandoned. Hence 9.4 conceptually shows that additional trucking as a result of branchline abandonment is a function of the miles abandoned.

---

[1] For example: Saskatchewan Wheat Pool, Analysis of Category "2" Rail Lines in Saskatchewan (Regina: Saskatchewan Wheat Pool, October 1975), p. 6. (Hereinafter referred to as (1975a).)

[2] Example: Ibid., p. 6.

## Net Extra Trucking Cost

$$NE8 = f\ (AT8,\ IT2,\ DI1,\ DI2,\ CO) \qquad 9.5$$

where:

NE8 = Net extra cost of trucking, in millions of dollars,

IT2 = Inland terminal receipts, in millions of bushels,

DI1 = Delivery incentive for trucking grain to country elevators, in thousands of dollars,

DI2 = Delivery incentive for trucking grain to inland terminals, in thousands of dollars,

CO = Compensation for additional trucking, in thousands of dollars.

The net extra cost of trucking is a vital side effect of rail line abandonment or use of inland terminals. Statement 9.5 sums the effects of variable levels in other subystems. Statement 9.5 is a conceptual presentation of accounting statement 9.5a which estimates the extra trucking cost, net of any incentives or compensation for the extra haul caused by branchline abandonment or use of inland terminals.

$$NE8 = t\ (AT8) + \sum_{i=1}^{x} (IT_i)\ (D_i)t - DI1 - DI2 - CO \qquad 9.5a$$

where:

$t$ = Marginal cost of trucking per bushel-mile,

$i=1,2,\ldots.x$ = Number of inland terminals,

$IT_i$ = Receipts at the $i^{th}$ inland terminal,

$D_i$ = Additional haul for trucking to inland terminals rather than local country elevators.

In 9.6a, the extra cost resulting from abandonment is the product of amount hauled (AT8) and marginal cost (t). Similarly, extra trucking as a result of shifting from elevators to inland terminals is a product of volume moved ($IT_1$), additional distance ($D_1$) and marginal cost (t). The above two extra costs are counter-balanced in any year by the total amount of delivery incentives introduced by elevator firms (DI1) or inland terminals (DI2). Total compensation (CO) also counter-balances extra cost and will be explained in the section on policy implications.

Time

$$TM8T = f\,((\underset{-}{IP/FP}),\ \underset{+}{TW},\ \underset{+}{SV6},\ \underset{+}{NF7}) \qquad 9.6$$

where:

TM8T = Time, in days, between announcement of a quota and delivery by a farmer,

IP/FP= Price ratio of initial price (IP) divided by feed price (FP)

TW = Total weather influence (measurement is defined in 6.2),

SV6 = Seasonal variation in producer marketings to elevators as measured by the coefficient of variation for monthly deliveries,

NF7 = Net farm income from grain.

Statement 9.6 is a behavioural model of time for both decision-making and physical delivery of grain. By definition, queueing time is included in TM8T. TM8T is unavailable for recent periods but could be obtained relatively simply by a Wheat Board cross-sectional survey of a sample of farmers. Such a survey should be done over enough quarterly periods and locations to make TM7T represent all permit holders. The question to ask of farmers is:

On what date did you fill Quota A? Quota B? etc. By comparing these responses to the date of quota announcement, the average farmer's response time (TM8T) could be estimated for different quarters. Quarterly data for the other variables would then be tested by regression for their significance in explaining TM8T.

Model 9.6 hypothesizes that:

1. As the relative price of export grain compared to feed grains (IP/FP) increases, farmers will more quickly deliver to the export market.

2. As farmers' net income increases (NF1), their need for money will decrease and hence the time before they decide to deliver will increase.

3. As the amount of bad weather increases (TW), delivery time will increase. Friesen[1] estimated the average delay in delivery on the Prairies due to bad road and weather conditions to be 16.3 days per farm in 1970.

4. As the month-to-month regularity of producer marketings increases (perhaps because of enforced termination of quotas), the response time will decrease. Conversely, as the regularity decreases (as measured by SV6), time will increase.

Investment

$$IN8S = f(\underset{+}{NF8}, \underset{+}{NF81}, \underset{+}{YR}, \underset{+}{NE8S}) \qquad 9.7$$

---

[1] Friesen, in Canada Grains Council (1973a), op. cit., p. 81.

where:

IN8S = Investment in farm trucks, in millions of dollars.

As in the farm storage investment model (9.1), the first three variables of 9.7 are taken from Denton's work. He estimated[1] investment in all farm equipment rather than just in trucks. Denton found investment very responsive to current and past income plus the time trend. Table 9.4 shows expected responses to changes in the income variables from Denton's models of investment. Total new and repair investment by farmers over two years increases by $480 in Alberta with a hypothetical increase in income of $1,000. While Manitoba is equally responsive at $473, Saskatchewan is less volatile at $297.

Table 9.4: Expected increases in new and repair investment in machinery and equipment associated with a hypothetical increase of $1,000 in farm net income, by province

| Province | Expected increase in investment expenditure: in the year which income increases | in the following year | in both years combined |
|---|---|---|---|
| Alberta | 276 | 204 | 480 |
| Saskatchewan | 166 | 133 | 297 |
| Manitoba | 239 | 234 | 473 |

Source: Denton, et. al., op. cit., p. 28-29.

---

[1] Denton, et. al., op. cit., p. 25.

At Hall Commission hearings attended by the author, farmers frequently indicated they would increase their investment in trucks if it were necessary to truck substantially more miles due to rail line abandonment or inland terminals. This behavioural response to extra truck output requirements is reflected by including NE8S with a positive sign in 9.7.

The author suspects 9.7 is unestimable for just truck investment. To get a truck investment estimate, one would omit NE8S and use Denton's model. By multiplying his investment in all equipment by the proportion of farm capital stock that is in farm trucks (available from census data), truck investment would be estimable.

Statement 9.7 completes the models for this subsystem. The policy implications for the trucking subsystem are assessed next.

### Policy Implications

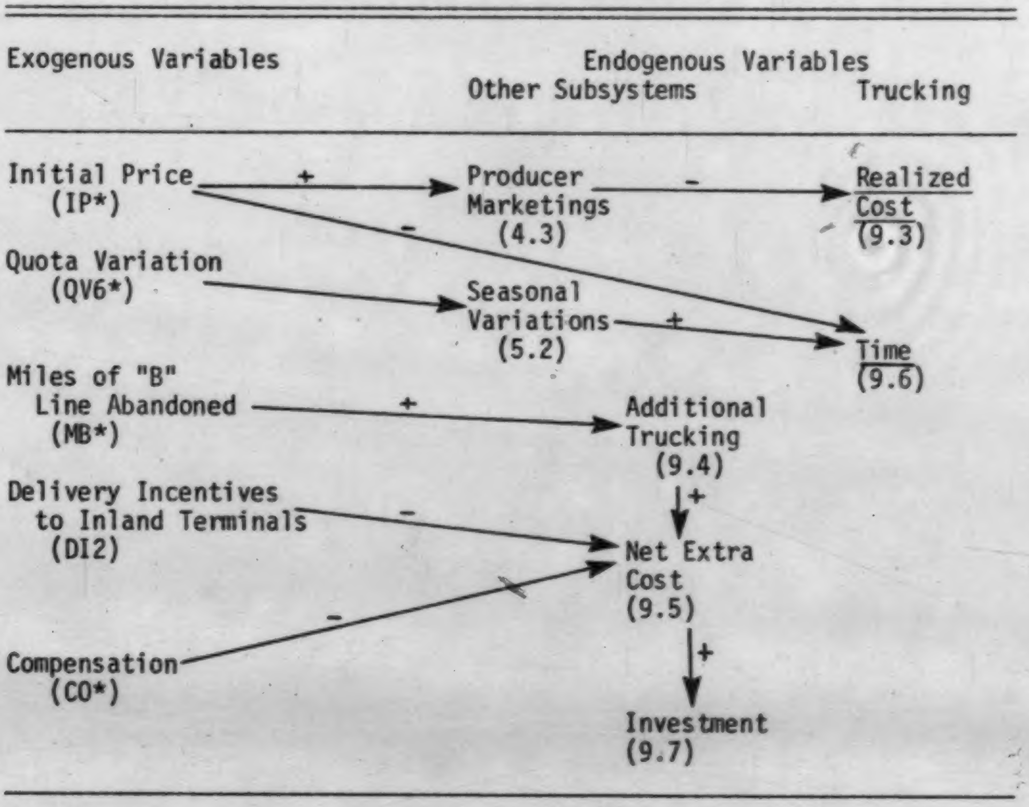
Figure 9.4 shows the instruments selected here and in other subsystems as controllable and effective in influencing cost and time targets plus investment and net extra cost of trucking. All instruments but compensation were introduced in other subsystems. For a discussion of unmeasurable side effects, see Chapters IV, V and VI.

Realized Cost -- Although increases in initial price (IP*) will, through producer marketings, effectively decrease realized costs, it is unrealistic to expect producer marketings (PM1) to be steered for that reason. Steering PM1 would more likely be solely for the income effect on farmers rather than the cost-reducing effect on elevators. Hence, the (IP*--RC1T) linkage is really a side effect of decisions elsewhere. It follows that the Wheat Board should be mindful of this indirect effect on RC8T when considering a reduction in initial prices.

The number of elevators and the inflation rate were rejected as uncontrollable factors in 9.3.

Time -- The initial price (IP*) and quota variation (QV6*) are selected as controllable instruments that affect time. Weather and farm income were rejected as uncontrollable. The author suspects increasing IP* to be more effective in decreasing TT6T than reductions in quota variations because of the very indirect linkage of QV6* through seasonal variation (statement 4.2). Hence IP* would be strongest instrument of the Wheat Board to speed up deliveries. Its simplicity and association with income (judged to be a large influence on $T^{M}$ T) augment its value.

Figure 9.4: Instrument-target linkages affecting trucking subsystem (#8)


Exogenous Variables
Endogenous Variables
Other Subsystems
Trucking
Initial Price (IP*)
+
Producer Marketings (4.3)
-
Realized Cost (9.3)
-
Quota Variation (QV6*)
Seasonal Variations (5.2)
+
Time (9.6)
Miles of "B" Line Abandoned (MB*)
+
Additional Trucking (9.4)
+
Delivery Incentives to Inland Terminals (DI2)
-
Net Extra Cost (9.5)
-
Compensation (CO*)
+
Investment (9.7)

Net Extra Cost of Trucking -- Both delivery incentives (DI1, DI2) are judged to be very effective in reducing NE8S. Yet DI2 is uncontrollable by central decisions, and (DI2) payments directly to farmers would be politically unacceptable to the Wheat Board.[1] Therefore DI1 and DI2 were rejected as instruments for this section. Should handling tariffs be raised, however, price statements 4.8 and 5.4 suggest both elevators and inland terminal firms could begin to use (DI1) and (DI2) to facilitate adjustment. (DI1) and (DI2) would in effect compensate farmers for additional trucking to a place and at a time suitable to the receiving facility. The author recommends here (as in Chapters IV, V and VIII) that handling tariffs be increased to permit freedom for additional adjustment and incentive through delivery incentives (DI1) and (DI7).

Compensation (CO*) was introduced as a variable to 9.5 to show the effect of the adjustment mechanism introduced below. CO* would work in parallel with compensation for roads and tax base losses (outlined in the next chapter). CO* is defined as follows. In the event of rail line abandonment:

a. A lump sum transfer is made to producers who must truck in excess of 15 extra miles and 20 miles in total to the nearest alternate delivery point.

b. The sum should come from the Federal transportation subsidy now paid to the railway for the uneconomic branchline in question.

---

[1] DI2 was chosen as a Wheat Board instrument (DI2*) in subsystem 2 yet DI2* was paid to truck grain from elevator companies whereas the above use of DI2 is for trucking from farms to inland terminals.

c. Total payment to all producers not be greater than seven years on-line railway costs saved by abandonment.

d. Payments be allocated to permit holders delivering to the line in proportion to their deliveries up to some limit and in proportion to the distance from the farmstead to the nearest alternate delivery point.

e. Payments per bushel-mile should be equal across the Prairies.

CO* is admittedly a "stab in the dark". Apedaile, et. al.,[1] identified the principles within which compensation should be made. Lang[2] has reportedly indicated compensation to farmers is being considered. CO* is offered in this study as a contribution to the debate. CO* has these advantages:

1. Section "a" suggests that compensation should go only to those suffering significantly. Twenty miles is a trucking limit discussed frequently at Hall Commission hearings as a reasonable upper limit (in the eyes of farmers). Any farmers required to go less than 15 additional miles were judged arbitrarily to a) not need a new truck and b) have acceptable marginal costs.

2. Section "a" suggests a once-in-a-lifetime payout because of:

---

[1] Leonard P. Apedaile, G. Murri and Murray H. Hawkins, "Branchline Abandonment - Impact on People - Approaches to Compensation," Alberta Transportation, Edmonton, January 1976. (Mimeographed.)

[2] Kulshreshtha (1975a), op. cit., p. 50.

i. Its simplicity and low-cost administration;

ii. Its avoidance of on-going debate about subsidy levels;

iii. Its incentive for the farmer to take positive action with the payout whether in buying a truck or diversifying to cattle or other enterprises.

3. Section "b" recognizes that the Federal Treasury, the biggest "winner" as a result of abandonment, should pay the farmer, one of the losers.

4. Section "c" identifies an upper limit to payout (arbitrarily set at seven years).

5. Section "d" identifies that compensation should be in proportion to individual loss (which varies as additional bushel-miles). The upper limit in bushels would proportionately cause bigger payouts to small farmers and thus have redistributive benefits while limiting total payout to larger farmers. Guidelines on the upper limit could come from clauses in the Grain Stabilization Plan.

6. Section "e" identifies the equity criteria that all producers be treated equally. However, Kulshreshtha[1] has suggested small farmers suffer greater marginal costs per mile than large farmers. He estimated at 0.13 cents per bushel spread between marginal costs of large and small farmers in 1974. Consequently, when deciding on abandonment, perhaps the Hall Commission and Canadian Transport Commission could consider farm size and retain branch lines in areas surrounded by small farmers. The equity question raised by Kulshreshtha and

---

[1] Kulshreshtha, (1975b), op. cit., p. 9

refinement of CO* is left to another study. CO*, through 9.7, also affects investment positively.

In summary, the trucking subsystem has no instruments, save a freeze on rail line abandonment, that currently affect cost targets. Wheat Board actions with respect to initial price and quota variation instrumentally affect time. While increased handling tariffs may indirectly reduce extra trucking costs from abandonment (through increased delivery incentives), a compensation proposal like CO* is the only clearly controllable instrument that positively affects extra cost and investment. A complementary compensation scheme is introduced in the next chapter.

# CHAPTER X

# PROVINCIAL AND MUNICIPAL GOVERNMENTS

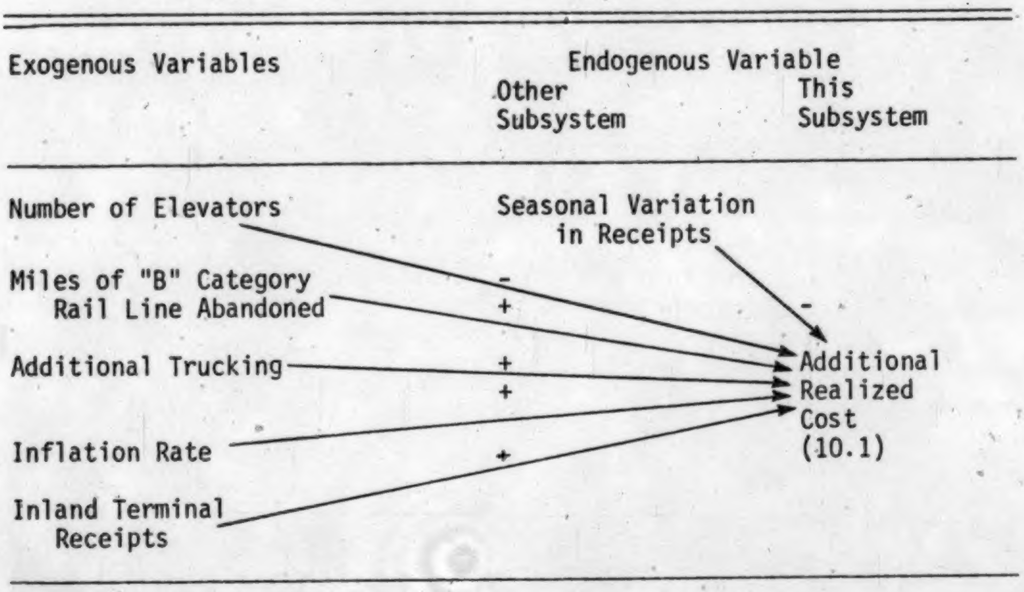
## Introduction

This chapter describes some of the external effects of changes in grain handling and transportation as they affect municipal and provincial governments in the Prairies. The subsystem is called "provincial or municipal governments subsystem" since these government levels often provide the leadership in identifying both their costs and any economic or social effects on citizens and businesses in the community. The subsystem is primarily concerned with the marginal (added) costs realized by subsystem stakeholders (AR9S). In Appendix B elements of AR9S are justified in a literature review on rural decline and elevator or branchline abandonment. Policy instruments and adjustment mechanisms to compensate losers for change conclude the chapter.

## Structural Relationships

Figure 10.1 identifies the logic between the six variables affecting additional costs realized by the municipal and provincial government subsystem as a result of changes to the grain handling and transportation system.

Figure 10.1: Logical relationships among exogenous and endogenous variables in provincial and municipal government subsystem (#9)


Exogenous Variables
Endogenous Variable
Other Subsystem
This Subsystem
Number of Elevators
Seasonal Variation in Receipts
Miles of "B" Category Rail Line Abandoned
Additional Trucking
Inflation Rate
Inland Terminal Receipts
Additional Realized Cost (10.1)
-
+
+
+
+
-

Realized Cost

$$AR9S = f\ (\underset{-}{NE}, \underset{+}{MB}, \underset{+}{AT8}) + f(\underset{+}{d(IT2)}, \underset{+}{IR}, \underset{-}{SV1}) \qquad 10.1$$

where:

AR9S = Additional Realized Costs to the provincial and municipal government subsystem, in thousands of dollars (net present value),

NE = Number of Elevator units,

MB = Miles of "B" Category Rail Lines Abandoned,

AT8 = Additional Trucking caused by elevator or branchline abandonment, in thousands of bushel miles,

SV1 = Seasonal Variation in producer marketings to elevators as measured by the coefficient of variation for monthly deliveries,

d = Average Distance of haul to inland terminals, miles, IT2 = Inland Terminal Receipts, in millions of bushels,

IR = Inflation Rate expressed as an index.

Statement 10.1 is an accounting statement that sums the effects of abandonment shown in (10.1a) and miscellaneous other changes to the system (10.1b).

$$AR9_1 = f\,(\underset{-}{NE},\ \underset{+}{MB},\ \underset{+}{AT8}) \qquad 10.1a$$

$$AR9_2 = f\,(\underset{+}{SV},\ \underset{+}{d(IT2)},\ \underset{+}{IR}) \qquad 10.1b$$

Statement 10.1a is estimable from 1975 cross-sectional data for each "B" category line in Alberta. Costs have been tabulated by Trimac Consulting Services Ltd.[1] and could, by 10.1a, be used to predict the realized costs of abandoning railways subdivisions in other provinces. For the purposes of this study, $AR9_1$ is defined as equivalent to the "cash impacts of abandonment" as developed by Trimac. These impacts included:[2]

1. Community and Municipal Cash Impacts:

   a. local portion of annual tax loss from rail line right-of-way and elevator facilities.

   b. forty percent of the annual salary of railway and elevator employees in centers on branchlines (a measure of trade loss in small centers affected by abandonment).

2. Province of Alberta Cash Impacts:

   a. annual tax loss from rail line right-of-way and elevator facilities

---

[1] Trimac Consulting Services Ltd., "An Evaluation of the Future Need for Rail Branchlines Proposed for Abandonment", Volumes I, II, III (Calgary, Alberta, 1975), table 5-8. (Mimeographed)

[2] Ibid., Volume III, sections 5.1 and 5.22.

b. additional highway capital and maintenance costs from the additional trucking from abandoned rail lines to a main line.

c. additional earnings from truck licenses and fuel taxes due to increased trucking.

Trimac collected taxes and salaries by a 100 percent survey of communities. Other costs were estimated. All were extrapolated over 25 years with no allowance for inflation. Annual costs and lumpy capital expenditures in highways were then combined by using present value calculations using 12 percent over 25 years. Table 10.1 shows as examples Trimac estimates for three subdivisions and all of Alberta. Other variables introduced in 10.1a are shown in Table 10.2 to facilitate following development of the statement.

Table 10.1: Net present value of realized costs to communities and the Government of Alberta resulting from possible rail line abandonment.

| Sector Receiving Cash Impacts | Sample Subdivision | | | All Alberta |
|---|---|---|---|---|
| | Acadia Valley | Stettler | Willingdon | |
| | - dollars - | | | |
| Communities | 5,900 | 966,900 | 289,950 | 8,836,865 |
| Government of Alberta | 260,300 | 231,600 | 523,040 | 7,679,797 |
| Total ($AR9_1$) | 266,200 | 1,198,500 | 812,990 | 16,516,662 |

Source: Trimac Consulting Services Ltd., op. cit., Table 5.8

Table 10.2: Number of elevator units, subdivision length, and bushel miles of additional truck haul, by subdivision

| Variable | Units | Subdivision | | |
|---|---|---|---|---|
| | | Acadia Valley | Settler | Willingdon |
| Number of Elevator Units (NE2) | no. | 2 | 19 | 16 |
| Subdivision Length (MB) | Miles | 23.7 | 108.0 | 80.8 |
| Additonal Trucking (AT8) | thousands of bu.-mi. | 10,514 | 33,249 | 69,216 |

Source: Canada Grains Council (1975a) op. cit., Table 9; Alberta Wheat Pool, op. cit., p.24

Statement 10.1a hypothesizes that tax losses to both the province and communities varies as the number of elevator units on that line (NE) and the miles of "B" category rail line (MB), since tax assessments are based on miles of track and size or value of elevator capacity. While elevator capacity data for the lines are available, the number of elevator units (NE) is used elsewhere in the model. Since NE should vary in proportion to capacity, it is included in 10.1a. A review of Table 10.2 confirms (NE) and (MB) vary as costs in Table 10.1.

Variables used by Alberta Transportation to estimate the road costs in Trimac calculations are too complex for reflection in a simple statement like 10.1a. Therefore, the author selected additional trucking distance and total volume (in bushels) on the line. Distance and volume are multiplied together to get bushel-miles of additonal trucking (AT8). The author anticipates (AT8) would explain most of the variation in the road cost component of $AR9_1$ between lines. The remaining variation in road costs should be explained by the variation in existing road inventory. No simple measure could be developed within the limits of this study.

Statement 10.1b reflects accounting adjustments for use of 10.1a under changed conditions. In future years, $AR9_1$ should be adjusted upward for inflation (as measured by IR). Seasonal variation (SV2) is introduced to reflect road cost reductions that can be gained by shifting the seasonal levels of producer marketings. According to road engineers,[1] reducing trucking to near zero from April 1 to June 15 and increasing trucking during the winter would substantially reduce annual maintenance costs on all roads (not just those affected by abandonment). That is, for every truckload shifted from the spring period into winter, road costs would move downward marginally. A shift in the timing of producer deliveries was measured in subsystem 2 by using seasonal variation (SV2) and is utilized in 10.1b. The positive coefficient for (SV2) would be an engineering estimate.

Finally, the introduction of more inland terminals or greater use of current terminals will radically adjust trucking patterns, perhaps even more than abandonment. Concentrations of large volumes on the roads near a terminal handling four to ten million bushels would cause large additional capital and maintenance costs.[1] The redirected traffic, as measured by bushel-miles of inland terminal receipts d(IT2), is introduced to reflect these additional road costs. Until a coefficient for d(IT2) is estimable, the coefficient for AT8 could be substituted.

---

[1] Earl Danchuk and Joe Glowath, Maintenance Branch, Alberta Transportation, Interview, Lethbridge, Alberta, March 5, 1976.

In conclusion, the accounting adjustments for inflation, seasonality, and inland terminals in 10.1b are added to realized costs of abandonment in 10.1a to get 10.1 defining the subsystem's total realized costs from changes in the handling and transportaiton system.

## Policy Implications

### Instrument Selection

Figure 10.2 indicates the four instruments already selected for other subsystems that affect costs realized by this subsystem (AR9S). The author could not find any new controllable instruments among the other variables of statement 10.2. None of the previously selected instrument variables shown in Figure 10.2 are controlled by provincial or municipal governments and their preferred movement is likely to increase AR9S. For example, in order to move towards more desirable levels of target variables in elevator or inland terminal subsystems, the Wheat Board would:

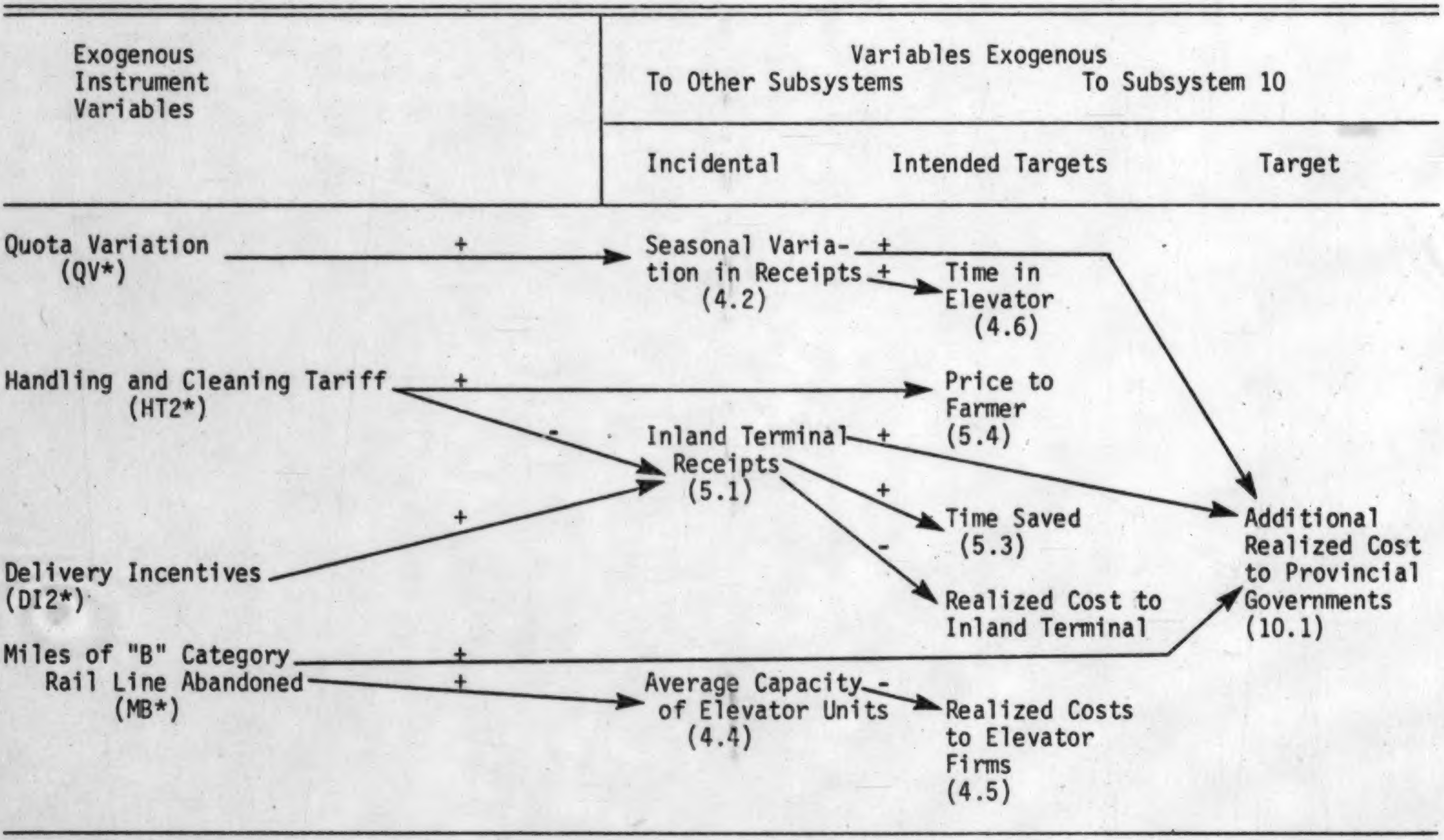
1. reduce quota variation (QV6*) and hence seasonal variation in receipts,

2. increase delivery incentives to inland terminals and

---

[1] Gordon Halls, Policy Development Section, Alberta Transportation, Interview, Edmonton, Alberta, April 28, 1976.

Figure 10.2: Instrument - target linkages in provincial and municpal governments subsystem (#10).


Exogenous Instrument Variables
Variables Exogenous
To Other Subsystems
To Subsystem 10
Incidental
Intended Targets
Target
Quota Variation (QV*)
Handling and Cleaning Tariff (HT2*)
Delivery Incentives (DI2*)
Miles of "B" Category Rail Line Abandoned (MB*)
Seasonal Variation in Receipts (4.2)
Inland Terminal Receipts (5.1)
Average Capacity of Elevator Units (4.4)
Time in Elevator (4.6)
Price to Farmer (5.4)
Time Saved (5.3)
Realized Cost to Inland Terminal
Realized Costs to Elevator Firms (4.5)
Additional Realized Cost to Provincial Governments (10.1)
+
-

hence inland terminal receipts.

More branchlines would be abandoned and the Canadian Grain Commission would reduce handling and cleaning tariffs. Each of the above moves passes an additional external cost on to the provincial and municipal subsystem as shown by the signs in 10.1. Since subsystem 9 cannot control these externalities, it must exercise influence on the level or mix of instruments by negotiation with the Canadian Wheat Board, Canadian Grain Commission and Hall Commission.

With regard to the level of each instrument, little can be said until statement 10.1 is estimated statistically. Comparison of net side effects of the four instruments as shown in Tables 4.2 and 5.2 suggest instruments be ranked as follows from best to worst: DI2*, HT2*, QV6*, and MB. Because the likely direction of all instrument movements is contradictory to lower external costs (AR9T), other instruments must be developed to offset decisions elsewhere in the System.

There are three possible institutional policies under the sole control of provincial and municipal governments. The first, licensing requirements for inland terminals, was rejected in Chapter V as discriminatory and ineffectual in compensating losers. In addition, such licensing would not affect deliveries to inland terminals already built. A second, the lowering of load limits on municipal roads, was also rejected in Chapter II because of its specific discrimination against grain and likely transfer of costs from municipal governments to farmers. A third institutional instrument, road bans, is currently used by both municipal and provincial governments. Additional enforcement and longer periods of road bans by municipal and provincial authorities could effectively reduce springtime receipts to near zero. Figure 4.3 suggests road bans are already effective in reducing springtime deliveries. The author recommends additional discussions between Wheat Board and road authorities to increase winter deliveries and stop spring deliveries altogether.

A final variable in 10.1 deserves additional attention. The number of elevator units (NE), while judged uncontrollable in Chapter II, may be a greater contributer to additional road costs than rail line abandonment. According to Halls,[1] the annual consolidation of points causes redirections in traffic that may, within a period of years, exceed the road effect of the abandonment of all "B" category lines in Alberta. The coefficients of (MB) and (NE) in 10.1 would provide some indication of the relative effect of consolidation and abandonment. The author recommends collaboration between operators of elevators or inland terminals and municipal and provincial road officials to minimize the effect and to adjust the timing of traffic pattern changes to new points.

## Institutional Policies

In view of the dilemma of external costs for this subsystem, the author suggests two institutional changes. Recommendation A: That the concept of off-track (satellite) elevators be spearheaded by provincial and municipal authorities with collaboration and policy support from other subsystems and the Federal Government.

---

[1] G. Halls, *op. cit.*

Such a concept involves removal of the branchline and provision of transportation service from selected remaining elevators by semitrailer trucks to the railhead. If a satellite elevator were to continue to operate after abandonment, most of the side effects of rail abandonment in Table 5.3 would be substantially reduced. Communities would still have the tax base from elevators, farmers could still rely on ancilliary elevator services like moisture testing, and agents would still contribute to town life. Farmers would not need to invest in larger trucks. Road costs would be less since large semitrailer trucks on one route between the satellite and railhead are less damaging to roads than many smaller farm trucks.[1]

At the time of writing, such a satellite elevator system was under consideration by the Hall Commission, Alberta Wheat Pool, and Alberta Transportation. MacLeod[2] indicates the Saskatchewan Wheat Pool has had little success with the concept because satellites:

a. are used by farmers only in the fall because after harvest farmers prefer to truck rather than pay an extra diversion charge.

b. cost an extra 18 to 20 cents per bushel for trucking and a second handling on the main line.

---

[1] Alberta Transportation, "Preliminary Summary of Road Costs Due to Possible Rail Line Abandonment Edmonton, Alberta, 1975, p. 3 (mimeographed.)

[2] MacLeod, Allen, Research Economist, Saskatchewan Wheat Pool, Interview, Regina, May 13, 1976.

MacLeod indicates satellites may be a useful adjustment mechanism for a time but they may also just encourage continued rigidity to change.

The Saskatchewan Wheat Pool difficulties could be overcome by the payment of satellite-to-railhead trucking. Such subsidy could be a Federal transfer in lieu of subsidies paid for current on-line rail costs. However, changes to the incidence and structure of rail freight rates (see Chapter VI) would provide funds for the rail head facility to pay the trucking from a satellite. That is, elevator or inland terminal firms could get a lower rail rate at high throughput points if throughput were increased and made more even. Planned trucking by large trucks from satellites during evenings or slow farm delivery periods would reduce queueing and increase throughput. Thus it would be in the interests of the trackside elevators to transfer part of its reduced rail freight rate to the cost of trucking grain from satellites.

Additional recommended policies for encouraging satellites are:

1. Make provision in Canadian Grain Commission regulations to move selected malting barley by truck direct to malt plants.

2. Establish criteria where satellites in isolated areas receive a trucking subsidy in lieu of branchline subsidies now received. Recommended criteria for paying subsidies are: greater than 20 miles by road from elevators to nearest on-track delivery point; previous handlings in excess of 400,000 bushels per year at satellite elevator and near by abandoned points.

3. Examine the satellite concept for areas not currently serviced by rail like La Crete, Fort Vermillion, and Valleyview, Alberta.

Recommendation B: That in view of the significant cost transfers in the event of rail abandonments ($AR9_1$), the federal treasury make once-in-a-lifetime compensational payments to provincial and municipal governemnts for selected abandonments. The level and allocation of compensation would be negotiated by the Provincial Ministers of Transportation, Hall Commission, and Ministry of Transportation.

The following proposal seems administratively simple:

1. Conditions before compensation considered:

a. rail line is still uneconomic after adjustments to rail rate levels and structure,

b. situation not feasible for construction of spurs,

c. situation does not fit criteria for introduction of a satellite elevator,

d. rail line carried enough grain to keep an elevator viable in 1975 (say 400,000 bushels).

2. Compensation by federal government:

a. a lump sum transfer to local municipalities for roads. Payment to be made at the time of abandonment to provincial governments of an amount equal to the costs of rehabilitating rail line to 220,000 pounds (capable of carrying light hopper cars).

Compensation as a tool of adjustment in the case of grain handling is clearly outlined by Apedaile, Hawkins, and Murri.[1]

---

[1] Apedaile, el

Responsibilities for compensation seem to be present in civil and environmental law. The author's work with citizens near "B" category lines suggests some measure of compensation would be considered just and far more acceptable than total abandonment. Compensation could be a plus to expectations of community leaders and supports provincial de centralization policies. Such Compensation would meet national transportation policy objectives of equity and isolation. The above proposals substitute better roads for removal of rail lines from isolated areas. In some cases federal transfers to road construction would be of greater benefit than retaining or rehabilitating the rail line since roads are used more than rail in the transport of people, cattle, farm inputs, etc.

## Summary

In statement 10.1 this chapter identified the additional external costs received by the provincial and municipal government subsystem as a result of rail line abandonment and inland terminals.

The level of quota variation (QV6) chosen for subsystem 1 would have a beneficial effect on roads. Rail line abandonment (MB*) is an instrument for elevator and rail subsystems that would add to realized costs for the provinces. Encouragement of satellite elevators and a federal compensation policy were suggested as means to offset the cost transfers as a result of abandonment.

## CHAPTER XI

## SUMMARY AND IMPLICATIONS FOR FURTHER STUDY

### Summary

Since the establishment of the Grains Group in 1969, much debate and study has focussed on problems and alternate solutions for one part or another of the grain handling and transportation system in Canada. Example questions analyzed include: What does it cost to move grain by truck and by train? Are inland terminals less costly to the farmer than high throughput elevators for handling grain? What branchlines, if any, should be abandoned? What are the effects of any abandonment? How can the grain throughput of the port of Vancouver be increased?

Farmers and researchers found the movement of grain was very complex, with institutional factors interwoven with production and marketing factors. Consequently, at the start of this study in 1971 (and even today in 1976) analytic work tended to focus on one or two aspects only. As well, until Grains Group and Canada Grains Council activity began, historical development of the institutional environment for grain handling and transportation had also focussed simultaneously on one, or at most two, parts of the System.

This study began with the purpose of providing a systematic analysis of the total grain handling and transportation system. In 1975, the Hall Commission on Grain Handling and Transportation was appointed to examine grain handling and railway transportation with an emphasis on evaluating Prairie branchlines. At Hall Commission hearings in Alberta, the author observed a continued lack of citizen willingness, or perhaps awareness, to evaluate all parts of the System and the many policy alternatives open to each part. A study was needed to a) simplify how parts relate and b) delineate policy alternatives.

A recent statement by the Honorable Otto Lang about transportation policy further indicates the need for a comprehensive policy analysis. He said[1] "the result (of historical policy initiatives) was a development... of a patchwork of transportation policies -- a patchwork that is really a pile, a series, a layer on layer -- of band aid solutions not necessarily so much to transportation problems as to political problems." He called for attempts[2] "to restore some systematic sensible analysis to our transportation situation and in the process to lift one by one those band aids which have been placed upon the system and which in the end keep us from seeing the system all together."

This study does not identify all the "band aids" applied to grain transportation nor does it include the breadth of public input available to the Hall Commission. However, the study attempted to rigorously identify the policy problems and objectives of the grain handling and transportation system. The study then examined some current "band aids" or policy instruments and described their influence on the performance of the whole System. Nine parts, or subsystems, were identified to approximate the System. These subsystems were: country elevators, inland terminals, railways, port terminals, Canadian Grain Commission, Canadian Wheat Board, farm storage, farm trucking, and provincial governments.

---

[1] Transport Canada, "Transcript of a Speech by the Honorable Otto Lang to The Vancouver Board of Trade Luncheon" (released by Directorate of Public Affairs, Ottawa, May 14, 1976), p. 3.

[2] Ibid., p. 3.

Simplification was an objective of this study. Nevertheless the complexity of the System required thirty-nine statements or functional forms to describe the relationships between important variables. These statements reflected the highly interrelated (or systems) nature of grain handling and transportation. A change in one variable (like the miles of branchline abandoned) will affect many other variables and subsystems. Quantitative specification of stakeholder targets in the Model simplified the assessment of cause-effect linkages between means (instruments) and ends (targets). Three targets were identified -- throughput time, realized cost, and price reflected to the farmer. When disaggregated among subsystems, the three targets increased to nineteen targets in total. Movement towards targets was inhibited by conditions that subsystems (a) generate investment and (b) make allowance for the additional costs to provincial and municipal governments. Six investment statements and one statement on additional provincial costs explain the factors affecting the inhibiting conditions.

In carrying out this study, individual statements or functional relationships were first defined for each target and inhibiting condition. Where necessary, intermediate or incidental variables were introduced to link instruments and other exogenous variables to targets. There were thirteen such incidental variables. Examples are amounts of dockage, rail traffic, inland terminal receipts and extra trucking costs. Diagrams were used extensively to clarify the linkages between exogenous and endogenous variables.

Once the relationships in a subsystem were defined, the study evaluated the exogenous variables and selected as instruments those variables judged to be controllable. The twenty-two instruments chosen were evaluated for their historical role as instruments, their efficiency (or influence), their administrative simplicity, and their side effects. Three results flowed from this analytic approach to instrument - target relationships.

First, the model and study aimed for comprehensiveness. It is felt that many of the operational, pricing, and policy considerations affecting System performance were reflected in the Model. The statements and many diagrams in the study traced both the linkages between instruments and targets and the linkages between instruments and unintended side effects on other variables.

Secondly from a policy point of view, the Model was overdetermined: there are more quantitative instruments (twenty-two in total) than target variables (nineteen in total). It follows that there are three degrees of policy freedom (22-19 = 3), so that in testing the Model, at least three instruments[1] could be set as constants and left out of the calculation of instrument levels necessary to reach fixed targets.

Thirdly, while conceptual in its approach, the study attempted to describe the large system as it now operates. Limitations to the study did not permit quantifying any of the 39 statements. The criteria of measurability was applied before variables were included. Unmeasureable variables were rejected unless they had significant policy implications or aided in the logic of the Model. Variables were defined specifically to utilize data currently available from the Canada Grains Council or Hall Commission on Grain Handling and Transportation. Much of the model could, therefore, be operationalized.

---

[1] Because four of the nineteen target variables (REST, TMST, TTST, TT6T) are summations of other target variables, there are really four additonal policy degrees of freedom for a total of seven policy degrees of freedom.

The Model's size, complexity, and, hence, data requirements, suggest operationalization would be of value to groups such as the following:

a) The Hall Commission on Grain Handling and Transportation,
b) Grains Handling and Transportation Committee of the Canada Grains Council,
c) The office of the Hon. Otto Lang, Minister Responsible for the Canadian Wheat Board, and Department of Transportation.

The author believes, however, that the conceptual approach in this study has enough value and simplicity at the subsystem level to be useful in committees, Boards of Directors, and classrooms that are studying the grain handling and transportation system.

For example: Chapter V on inland terminals, with its diagrams showing linkages, could be useful for provincial governments and farm organizations as they develop policies to encourage or discourage inland terminals. By following the linkages backwards[1] from targets through incidental variables to variables exogenous to the inland terminal subsystems, policy-makers can identify what uncontrollable and controllable factors confront them. Using Figure 5.1, for example, if potential investors conclude certain factors like the rail rate structure (CR3*) and money for delivery incentives (DI2) are not favourable to investment, they may not choose to invest until these factors become favourable. Policymakers may, however, wish to generate investment even if the rail rate structure or delivery incentives appear unfavourable and cannot be changed at that time. Therefore, to encourage investment, Figure 5.1 suggests policymakers can choose between increasing the credit available (CR2*) or increasing handling tariffs (HT2*). If these two instruments are ineffective, policymakers must either revamp their targets or cause changes to the rail rate structure (CR3*) and delivery incentives (DI2).

---

[1] That is moving in a direction opposite to the arrows (right to left).

In a similar way, branchline abandonment was identified as one of the instruments available to reduce costs to country elevators. To reduce time in elevators, policymakers can choose between reducing the storage tariff, reducing the variation in quota, or increasing handling tariffs. The study describes how higher handling tariffs not only encourage investment but also facilitate payment of trucking incentives that could compensate farmers for loss of their elevators.

When policy means to reduce railway costs were analyzed, the study found policymakers can choose between rail line abandonment, reductions in institutionalized costs (like excessive crew sizes), or reductions in the cost of capital. Autonomous government investment in roadbed or rolling stock ranked as a preferable instrument to cause investment that increases to the cost of capital.

The analysis of instruments affecting key variables in port terminals found the level of dockage and inland terminal receipts to be influential. Hence, handling tariffs, cleaning tariffs, and trucking programs for inland terminals were instruments open to policymakers. These instruments were more indirect in reducing time and cost than regulation of port storage levels and reductions in the number of grades. The recent Wheat Board incentive for investment in Vancouver terminal storage capacity was assessed and found less preferable to a tax incentive on new storage investment.

The Canadian Wheat Board and Canadian Grain Commission have a broad range of instruments available to them to affect the levels of time, cost and price to the farmer in other subsystems. Changes in country elevator storage stocks, the level of handling tariffs and delivery incentives to inland terminals were found to be instruments particularly influential.

Storage and trucking subsystems are affected by policy choices for ohter subsystems. A tax incentive for storage investment was identified to reduce storage costs. Branchline abandonment increases trucking costs; a higher handling tariff at elevators would permit firms to compensate farmers trucking further. Since such compensation may not be equitable enough, a once-in-a-lifetime Federal compensation program was described for use in the event of abandonment of certain isolated rail lines.

Any major adjustments to the number and location of country elevators, inland terminals, and branchlines were found to cause additional costs to provincial and municipal governments. Except for fighting abandonment, provincial governments have few instruments to reduce the transfer of rail and elevator costs to road costs. Manipulation of the quota system to encourage winter trucking was suggested as a means to make marginal reductions in road costs. Encouragement of off-track or satellite elevators and a Federal compensation program were identified as policies capable of easing the burden of adjustment resulting from branchline abandonment.

### Areas Identified for Institutional Change

In subsystems where the quantitative instruments were judged to be insufficiently effective to move the System towards targets, institutional policies were developed and evaluated. Institutional policy changes identified include:

1. Changes to the level and structure of the statutory rate on grain and introduction of both a subsidy and a volume incentive for grain transportation by rail.
2. Encouragement of the concept of satellite or off-track elevators.
3. Federal compensation for additional road costs to provincial and local governments in the event of certain kinds of rail line abandonment.
4. Federal compensation to farmers where branchline abandonment creates excessive additional trucking.
5. Less regulation of handling tariffs in order to ease System adjustment.

Additional study by the Hall Commission and others is necessary to assess all the implications of the above structural or institutional policy adjustments.

## Reservations and Implications for Further Study

The size and pre-estimation stage of the Model inhibited several important tests and limited policy conclusions up to this point in the research. To effectively test the validity of the logic of functional forms, as well as the logic of the whole system, the statements should be estimated by regression techniques. Statistical testing would no doubt improve specification and could modify the qualitative policy implications in some cases. Once estimated, the matrix of coefficients should be tested for identifiability. A reduced form, organized with the aid of computer facilities, would permit inferences about the degree of recursiveness and therefore, decision-making freedom, that exists for steering instruments in each subsystem.

The trade-off made in the study between simplicity and comprehensiveness has created a product which reflects the complexities of grain handling and transportation in a step by step yet detailed manner. The System is not simple and therefore, modelling its behaviour is also not simple. One avenue of simplification would be to reduce the number (eleven) of incidental variables. Such a move may, however, camouflage the effect of the many policy instruments and interactions or interfaces between subsystems.

Four concepts in the Model are somewhat crude and merit early testing. First, time as a proxy for effectiveness is not only very difficult to measure but may also be highly correlated with realized cost and price to the farmer. While introduced to measure concern for System effectiveness, time may well be less of a valued performance indicator than is suggested in this study. Second, the investment models are based on general theory and would be very difficult to measure at disaggregated subsystem levels. Additional behavioural research is needed at the subsystem level to determine the importance of investment and the factors affecting the level of annual investment.

Third, the issue of compensation for farm trucking and provincial subsystems needs additional refinement to deal with the question of equity. Fourth, the side effects charts need close scrutiny. Initial and lagged effects were combined into one negative or positive sign. These effects should be separated. The positive and negative signs in the charts are normative and need further study.

In future studies, certain assumptions should be altered or tested. First, additional attention should be given to quantifying the positive effects of elevator consolidation and branchline abandonment. Improvements to comparative advantage through livestock production, increased truck employment and better market information at larger, better staffed inland terminals are some of the possible positive effects of branchline abandonment. Other issues requiring study because of their affect on the grain handling and transportation system are feed grain policies, non-homogeneity of grain, storage policy, and use of rail transportation for grain movement within the Prairies.

Skeptics state that models like those developed in this study in fact complicate the obvious and omit the subtle. Despite its limitations, this conceptual model was found useful in the author's work with citizens and government officials concerned with grain handling and transportation. Like Richard Stone, the author finds that:

> The model builder who wants to see his models put to practical use commits himself to a life of working with others. The idea that economic models can be useful is a comparatively new one and is resisted by many people from some vague apprehension that, once accepted, the models will begin to run their own lives.[1]

---

[1] Richard Stone, "Models of the National Economy for Planning Purposes," Operational Research Quarterly, Vol. 14 (1963), pp. 51-59.

# BIBLIOGRAPHY

ALBERTA Transportation. "Preliminary Summary of Road Costs due to Possible Rail Line Abandonment of Category B Lines Only." Edmonton, Alberta, 1975. (Mimeographed.)

ALBERTA Wheat Pool. "Brief to the Grain Handling and Transportation Commission." Calgary, Alberta, November 1975. (Mimeographed.)

APEDAILE, Leonard P., Daryl G. Murri, Murray H. Hawkings. "Branchline Abandonment - Impact on People - Approach to Compensation." Alberta Transportation, Edmonton, January 1976.

BAYDA, Justice E.D.. "Report of the Industrial Inquiry Commission Under the Canadian Labor Code into the Grain Handling Industry in the Vancouver Port Area." Minister of Labor, Ottawa, Ontario, July 1975. (Mimeographed.)

BECKMAN, Martin. *Location Theory*. New York: Random House, 1968.

BERGSTROM, Joan. "Brief to the Grain Handling and Transportation Commission by Edberg Social Studies 20 Class." presented at Donalda, Alberta, February 24, 1976. (Mimeographed.)

BISCHOFF, Charles W. "Business Investment in the 1970's: A Comparison of Models." *Brookings Papers on Economic Activity*, 1(1971), pp. 13-57.

BOARD of Grain Commissioners. *Grain Cleaning in Canadian Elevators*. Winnipeg: Queen's Printer, 1971.

BRYDON, Rod. "County Terminals." Ottawa, Ontario, 1975. (Mimeographed.)

BYARNASON, Emil. *Operational Aspects of Contractural Arrangements for the Port of Vancouver Terminals Grain Handling and an Exploration of Alternatives*. Vancouver: Western Transportation Advisory Council, August, 1975.

CANADA Grains Council. "Sub-Committee Report on Market Specifications for Canadian Grains." Winnipeg: CGC, April 1976. (Mimeographed.)

CANADA Grains Council. *Area Eleven Study*. Winnipeg, Manitoba: CGC, 1975(a).

CANADA Grains Council. *An Assessment of Selected Studies in Grain Handling and Transporation*: Winnipeg, Manitoba: CGC 1973(a).

CANADA Grains Council. *Definition of the Problem*. (Winnipeg: Canada Grains Council, 1975(b).

CANADA Grains Council. *The Grain Handling and Transportation System in the Brandon Area*. Winnipeg, Manitoba: CGC, 1974(a).

CANADA Grains Council. "Grain Handling and Transportation." *Fact Sheet No. 2*. Winnipeg, Manitoba: CGC, 1972.

CANADA Grains Council. *Grain Handling and Transportation Information Booklet*. For Areas 13, 14, 15, 16, 17. Winnipeg: Canada Grains Council, 1975(c).

CANADA Grains Council. *State of the Industry Report*. Winnipeg, Manitoba: CGC, 1973(b).

CANADA Grains Council. *Statistical Handbook*. Winnipeg: Canada Grains Council, 1974(b), 1975(d).

CANADIAN Cattle Commission. "Submission to the Hall Commission." Calgary, Alberta, November 13, 1975. (Mimeographed.)

CANADIAN Grain Commission. *Annual Report*. Ottawa: Queen's Printer, 1971, 1972, 1973, 1974.

CANADIAN Grain Commission. "Report of the Tariff Review Committee to the Canadian Grain Commission." Winnipeg, Manitoba, 1974(a). (Mimeographed.)

CANADIAN International Grains Institute. *Grains and Oilseeds: Handling, Marketing and Processing*. Books I, II, III. Winnipeg: Canadian International Grains Institute, March 1973.

CANADIAN Transport Commission. *Factors Influencing the Choice of a New Delivery Point and Elevator Company by Prairie Farmers Facing Delivery Point Closure*. Ottawa: Canadian Transport Commission, Economics Branch, 1972.

CANADIAN Transport Commission. *Prairie Grain Handling and Transportation Background Data*. Study Areas 11, 13, 14, 15, 16, 17. Ottawa: Queen's Printer, 1975, 1976.

CANADIAN Wheat Board. *Annual Report*. Winnipeg, Manitoba: CWB, 1971-72, 1972-73, 1973-74, 1974-75.

CANADIAN Wheat Board. "Report on Test of Commercial Truck Movement of Barley from Country Elevators to Canadian Government Interior Terminals." Winnipeg, Manitoba, 1972. (Mimeographed.)

CARGILL. "Submission to the Grain Handling and Transportation Commission." Presented at Winnipeg, Manitoba, October, 1975. (Mimeographed.)

C.D. HOWE Western Ltd. "Report on Potential for Expansion of Vancouver Grain Terminals." Report to Harbors Board, Vancouver, June 1972, (Mimeographed.)

CHANNON, J.W., Chairman, Alberta Grain Commission. Interview. Edmonton, Alberta, May 6, 1976.

CHAUDHERY, G. Nabi. Motor Truck Transportation of Grain to Inland Terminals in Western Canada, 1973-74. Bulletin 200/6/75. Edmonton: Alberta Agriculture, Production Economics Branch, May 1975.

CHRIST, Carl F. Econometric Models and Methods. New York: John Wiley and Sons, 1966.

CLAVEL, Pierre and P. Everts. "The Organization of Data for Public Policy." Paper presented at Rural Sociology Society Annual Meeting, Denver, Colorado, 1971.

C.N. RAIL. "Submission to the Grain Handling and Transportation Commission." Presented in Winnipeg, Manitoba, October, 1975.

C.P. RAIL. "Submission to the Commission on the Costs of Transporting Grain by Rail." Vol. III Winnipeg, Manitoba, April 1975. (Mimeographed.)

C.P. RAIL. "Submission to the Grain Handling and Transportation Commission." Presented in Winnipeg, Manitoba, October, 1975.

C.P. RAIL. "Submission to the Standing Committee on Transportation." Montreal, Quebec, October, 1974. (Mimeographed.)

CROWN, R.N.. "Project Outline for Study of the Rural Development Implications of Branchline and Elevator Rationalization in West Central Saskatchewan Area." Ottawa: Agriculture Canada, Economics Branch, 1975. (Mimeographed.)

DANCHUK, Earl and Joe Glowath, Maintenance Branch, Alberta Transportation. Interview. Lethbridge, Alberta, March 5, 1976.

DAVIS, G.J. and D.G. Stephens. "The Canadian Wheat Board's Terminal Planning Division." Grains and Oilseeds Handling Marketing and Processing. Winnipeg: Canadian International Grains Institute, 1973.

DENTON, Frank T., D. Freshwater and A.L. Robb. Prices, Incomes and Capital Formation in Canadian Agriculture. Ottawa: Food Prices Review Board, March 1975.

DERNBERG, Thomas F. and McDougal, D.M. Macroeconmics. Toronto: McGraw-Hill, 1963.

DEVER, D.A. "The Effects of the Crowsnest Pass Railway Rates." Crows Nest Transportation Seminar Papers. Edmonton, Rural Education and Development Association, 1975.

DIERCKZ, John F. "Grain at Prince Rupert." Department of Transportation, Edmonton, 1975. (Mimeographed.)

"DOCKAGE Costs Money." Agri News (Alberta Department of Agriculture News Release), January 8, 1973.

ECONOMIC Council of Canada. Design for Decision-Making. Ottawa: Queen's Printer, 1971.

EYVINDSON, Roger K. National and Regional Economic Models of Agriculture. Pub. 72/9. Ottawa: Economics Branch, Agriculture Canada, 1972.

FAST, H.R. and D.A. Neil. Stettler Region of Alberta. Prairie Regional Studies in Economic Geography No. 18. Ottawa: Economics Branch, Agriculture Canada, 1975.

FAST, Henry R. "Changing Communities in Rural Saskatchewan." Canadian Farm Economics, Vol. 7, No. 2 (1972), pp. 8-19.

FOOD Prices Review Board. Feed Grains Policy in Canada. Ottawa: Food Prices Review Board, December 1975.

FOX, K.A., J.K. Sengupta and E. Thorbecke. The Theory of Quatitative Economic Policy. Chicago: Rand McNally and Co., 1966.

FRIESEN, B.A. "Farm Stored Grain on the Prairies." In: Canada Grains Council. An Assessment of Selected Studies in Grain Handling and Transportation. Winnipeg, Canada.

FRIESEN, Bruno A. "Summary of Response to an Attitude Questionaire Conducted with Grain Producers." Calgary, Alberta Wheat Pool, 1971. (Mimeographed.)

GILCHRIST, Varge. "Background and Purpose of the Symposium." National and Regional Econmic Models of Agriculture. Ed. by Roger K. Eyvindonson. #72/9. Ottawa: Economics Branch, Agriculture Canada, 1972.

GOVERNMENT of Alberta. Submission to the Grain Handling and Transportation Commission. Edmonton: Alberta Transportation, 1975.

GRAIN Co-Ordination Committee. "The Case for Expanded Grain Facilities in Prince Rupert." Prince Rupert, 1975. (Mimeographed.)

GRAIN Handling and Transportation Commission. "Terms of Reference." Saskatoon, Saskatchewan, 1975. (Mimeographed.)

"GRAIN Ships Delayed at Vancouver." Globe and Mail, March 1, 1974, p. B.9.

HALLS, Gordon, Policy Development Section, Alberta Transportation. Interview. Edmonton, Alberta, April 28, 1976.

HILL, Lowell D. "Economic Determinants of the Farm and Elevator Trends in the Volume of Corn Artificially Dried." American Journal of Agriculture Economics, Vol. 52, No. 4 (November 1970), pp. 563-568.

HILLS, Nick. "Money to Ease Grain Flow." Winnipeg Tribune, April 14, 1976, p. 10.

HIRSCHMAN, A.O. and C.E. Lindbloom. "Economic Development, Research and Development, Policy Making: Some Converging Views." Systems Thinking (Selected Readings). Ed. by E.E. Emery. Suffolk, United Kingdom; Penguin, 1969.

HODGE, Gerald. "Branch Line Abandonment: Death Knell for Prairie Towns?" Canadian Journal of Agricultural Economics, Vol. 16, No. 1 (1968), p. 54.

HONEY, G.K. A Memorandum to the Canadian Taxpayer: The High Cost of Strikes in the Food Distribution System. Calgary: Alberta Wheat Pool, 1975.

HORNER, Jack, M.P. "Submission to the Hall Commission" at Consort, Alberta, March 30, 1976. (Mimeographed.)

INTERNATIONAL Labor Office. Introduction to Work Study. Geneva: Atar, 1962.

JORGENSON, Dale W. and Calvin D. Siebert. "A Comparison of Alternative Theories of Corporate Investment Behaviour." American Economic Review, Vol. 58, No. 4 (1968), p. 681.

KAHN, Alfred J. Theory and Practise of Social Planning. New York: Russell Sage Foundation, 1969.

KAPLANIS, A.N. "Review of Activities of the Thunder Bay Sub-Committee." Winnipeg, Canada Grains Council, 1976. (Mimeographed.)

KATZ, S.M. "Administrative Capability and Agriculture Development: An Institution-Building Approach to Evaluation." Journal of Agricultural Economics, Vol. 52, No. 5 (1970), p. 797.

KENNEDY, Dennis, Assistant Director, Econmics and Statistics Division, Canada Grain Commission. Interview, April 27, 1976.

KULSHRESHTHA, Surendra N. A Current Perspective on the Prairie Grain Handling and Transportation System. Bulletin No. 269. Saskatoon: Extension Division, University of Saskatchewan, September 1975(a).

__________. An Examination of the Inland Terminals Approach in Rationalizing the Prairie Grain Handling and Transportation System. Bulletin No. 266. Saskatoon, Saskatchewan: Extension Division, University of Saskatchewan, 1975(b).

__________. "Ownership of Farm Trucks for Hauling Grain: An Application of Multivariate Logit Analysis." American Journal of Agriculture Economics. Vol. 57, No. 2. (May 1975), p. 302. (1975c).

__________. Costs of Owning and Operating Farm Trucks for Grain Hauling in Saskatchewan. Bulletin 74-09. Saskatoon: Department of Agricultural Economics, July 1974.

MACLEOD, Allan. Research Economist, Saskatchewan Wheat Pool. Interview. Regina, Saskatchewan, May 13, 1976.

McRAE, D.R. "Report on the Activities of the Pacific Coast Sub-Committee." Winnipeg, Canada Grains Council, 1976. (Mimeographed.)

MANITOBA Pool Elevators. "Submission to the Grain Handling and Transportation Commission." Winnipeg, Manitoba, October 1975. (Mimeographed.)

MANTS, J.F. "A Review of Car Allocation Procedures." Office of the Minister in Charge of the Canadian Wheat Board, Ottawa, Ontario, September 1975. (Mimeographed.)

MAZANKOWSKI, Don, M.P. "Submission to the Grain Handling and Transportation Commission." Ottawa, Ontario, January 1975. (Mimeographed.)

MCMORRIS, G., H. Northcott, M. Monner, et. al. "Milo-Queenstown Community Brief to the Grain Handling and Transportation Commission." Presented at Arrowwood, Alberta, March 18, 1976. (Mimeographed.)

MCRAE, D.R. "Report on the Activities of the Pacific Coast Sub-Committee." Canada Grains Council, Manitoba 1976. (Mimeographed.)

NADLER, Gerald. Work Systems Design: The Ideals Concept. Homewood, Illinois: Richard Irwin Inc., 1967.

OLSEN, H.D. and J.A. Brown. A Study of the Growth of Selected Service Centers in Saskatchewan. Bulletin RR-75-03. Saskatoon: Department of Agricultural Economics, University of Saskatchewan, January 1975.

OLSON, Hon. Bud. "Submission to the Hall Commission." Presented at Iddesleigh, Alberta, March 25, 1976. (Mimeographed.)

OWEN, C.H. and D.G. Stephens. "Canadian Grain Commission." Grains and Oilseeds Handling, Marketing and Processing. Book 1, A.3. Winnipeg: Canadian International Grains Institute, 1975.

P.S. ROSS and Partners. *Grain Handling and Transportation Costs in Canada*. Prepared for Grains Group, Office of the Minister for the Canadian Wheat Board, Ottawa, Canada, August 1971. (Mimeographed.)

PEACE Agra Cooperative Ltd. "A New Generation Concept for Crop Handling Stations and Transportation System." Fairview, Alberta, 1975. (Mimeographed.)

PENNINGTON, Mary. "Presentation to Grain Handling and Transportation Commission." Presented at Consort, Alberta, March 30, 1976. (Mimeographed.)

PIONEER Grain Company Limited. "Submission to the Grain Handling and Transportation Commission." Presented at Winnipeg, Manitoba, November 1975. (Mimeographed.)

PORT of Churchill Development Board. "Submission to the Grain Handling and Transportation Commission." Presented at Winnipeg, March 1976. (Mimeographed.)

POUND, H.D. "Plain Facts About Grain Handling and Storage Tariffs." *Proceedings of the Grain Handling and Transportation Seminar.* (University of Saskatchewan and Canada Grains Council, March 1973.)

PROKOSCH, Ronald E. "Planning-Programming-Budgeting - A Case Study: The Federal Department of Manpower and Immigration." Unpublished research paper, Carleton University, Department of Political Science, Ottawa, 1970.

SASKATCHEWAN Wheat Pool. *Analysis of Category "2" Rail Lines in Saskatchewan*. Regina: Saskatchewan Wheat Pool, October 1975(a).

SASKATCHEWAN Wheat Pool. *Submission to the Commission of Grain Handling and Transportation*. Regina: Saskatchewan Wheat Pool, October 1975(b).

SCHULTZ, Charles L. *The Politics and Economics of Public Spending*. Washington: Brookings Institute, 1968.

SHEPP, R.J. "Transporation of Western Canadian Grain - Problems and Prospects." Paper presented to Canadian Transportation Research Forum, Winnipeg, May 1970.

SHURSON, G.W. "A Study of the Impact of a Rationalized Grain Handling Industry on Roads and Highways of Saskatchewan." Quoted in Surendra Kulshreshtha, *A Current Perspective on the Prairie Grain Handling and Transportation System*. Bulletin No. 269. Saskatoon: Extension Division, University of Saskatchewan, September 1975.

STABLER, J. "The Impact of Rail Line Abandonment and Grain Elevator Removal on Rural Communities." Proceedings of *Grain Handling and Transportation Seminar*. (University of Saskatchewan and Canada Grains Council, 1973).

STICKLAND, Ken W. "Issues at Snavelly Commission Hearing." Alberta Tansportation, Edmonton, Alberta, May, 1976. (Mimeographed.)

STONE, R. "Models of the National Economy for Planning Purposes." *Operational Research Quarterly*, Vol. 14 (1963), pp. 51-59.

SUDERMAN, P.A. and D.G. Stephens. "The Canadian Wheat Board." *Grains and Oilseeds Handling, Marketing and Processing*. Book A.3. Winnipeg: Canadian International Grains Institute, 1973.

TINBERGEN, Jan. *On the Theory of Economic Policy*. (Amsterdam: North Holland Publishing Co., 1966.

TRANSPORT Canada. "Lang Comments on Rapeseed Freight Rate Changes." News Release from Directorate of Public Affairs, Transport Canada, Ottawa, May 4, 1976.

TRANSPORT Canada. "Transcript of a Speech by the Honourable Otto Lang to the Vancouver Board of Trade Luncheon." Released by Directorate of Public Affairs, Ottawa, May 14, 1976.

TRIMAC Consulting Services Ltd. "An Evaluation of the Future Need for Rail Branchlines Proposed for Abandonment." Volumes I, II, III. Calgary, Alberta. (Mimeographed.)

TYRCHNIEWICZ, Edward W. and Robert J. Tosterude. "A Model for Rationalizing the Canadian Grain Transportation and Handling System on a Regional Basis." *American Journal of Agricultural Economics*, Vol. 55, No. 5 (1973) pp. 810-811.

UNDERWOOD, McLellan & Associates Ltd. *Economic Effect of Rationalization of the Grain Handling and Transportation System on Prairie Communities*. Saskatoon, Saskatchewan, 1972.

UNIFARM "Brief to the Grain Handling and Transportation Commission." Presented in Edmonton, Alberta, November, 1975.

UNIFARM "Trans-Com Kit" Edmonton, Alberta, December, 1976. (Mimeographed.)

UNITED Grain Growers. "Submission to the Grain Handling and Transportation Commission of Inquiry." Winnipeg, Manitoba, 1975. (Mimeographed.)

"WARNS About Costs of Rationalization." *Western Producer*, November 23, 1972, p. 11.

WARRACK, Allan A. "An Analysis of Inflation Impact on Local Governments in Canada." Unpublished study for Prices and Incomes Commission, Ottawa, 1970.

"WHAT Should be Done with the Railways?" A Special Section of the Western Producer, July 31, 1975. (Regina: Modern Press.)

ZASADA, D. "The Probable Effects of the Application for Railway Branch Line Abandonment on the Grain Elevator Industry." Canadian Farm Economics, Vol. 3, No. 1 (1968), p. 20.

ZIMMERMAN, C.C. and Garry Moneo. The Prairie Community System. Ottawa: Agricultural Economics Research Council, 1971.

# APPENDIX A

## ESTIMATION OF REALIZED COSTS

Estimates of the realized costs for all subsystems in Table 3.2 (Chapter III) have three basic sources, according to year. The 1969/70 estimates are based on the Grains Group original studies including the summary by P.S. Ross. Many 1971/72 estimates are taken from the State of the Industry report. The 1973/74 estimates are selected from a range of studies. Table 3.2 is restated below; notes identifying the source of each calculation follow the table.

Table 3.2: Estimated realized costs, per bushel, by subsystem for 1969/70, 1971/72, 1973/74

| Item | Year<br>1969/70 | <br>1971/72 | <br>1973/74 |
|---|---|---|---|
| Producer Marketings (millions of bushels) | 675[a] | 950[e] | 879[g][i] |
| Subsystem | | cents per bushel | |
| Farm Storage and Handling[b] | 5.0 | 5.5 | 6.0 |
| Farm Trucking | 3.2[c] | 3.7[f] | 4.9[f] |
| Country Elevator | 12.4[a] | 12.2[e] | 14.0[j] |
| Railway | 29.9[a] | 25.5[g] | 42.9[k] |
| Port Terminals | 6.9[a] | 6.1[h] | 6.8[h] |
| Canadian Grain Commission Deficit[d] | 0.9 | 0.4 | 0.7 |
| Wheat Board Marketing Costs | 5.1[c] | 2.5[c] | 9.3[i] |
| Total | 63.4 | 55.9 | 84.6 |

[a] P.S. Ross and Partners, "Grain Handling and Transportation Costs in Canada" (Ottawa: Office of the Minister for the Canadian Wheat Board, 1971), p. 26.

[b] Canada Grains Council, An Assessment of Selected Studies in Grain Handling and Transportation (Winnipeg: Canada Grains Council, 1973), p. 80, and author's arbitrary addition of 10 percent inflation per year for 1971/72 and 1973/74 estimates.

[c] Canada Grains Council, "Grain Handling and Transportation,," Fact Sheet No. 2 (Winnipeg, Manitoba: Canada Grains Council, 1972), p. 1.

[d] Canadian Grain Commission, Annual Report (Ottawa: Queen's Printer, 1970, 1972, 1974). Author's estimates derived by dividing Commission deficit by producer marketings.

[e] Canada Grains Council, State of the Industry (Winnipeg: Canada Grains Council, 1973), p. 108 and author's estimates.

[f] Surendra Kulshreshtha, An Examination of the Inland Terminals Approach in Rationalizing the Prairie Grain Handling and Transportation System, Bulletin No. 266 (Saskatoon: Extension Division, University of Saskatchewan, 1975), p. 8.

[g] Canada Grains Council, Definition of the Problem (Winnipeg: Canada Grains Council, 1975), p. 26.

[h] *Ibid*., pp. 20-24 and author's estimates.

[i] Canada Grains Council, Statistical Handbook (Winnipeg: Canada Grains Council, 1975), p. 200, and Table 45.

[j] Indicative average of elevator cost for 300,000 bushel receipt at 125,000 bushel elevator. See: Canada Grains Council, Information Booklet, Area 15 (Winnipeg: Canada Grains Council, 1975), Table 20.

[k] Author estimate by multiplying the statutory rate by the ratio of cost-to-revenue. See Table 3.3 for the average statutory rate of 13.8 cents. The cost-to-revenue ratio of 3.11 is an average of provincial and railway viewpoints (line 4 of Table 6.1).

# APPENDIX B

## LITERATURE REVIEW ON THE EFFECTS ON PRAIRIE COMMUNITIES OF CHANGES TO THE GRAIN HANDLING AND TRANSPORTATION SYSTEM

### Political and Social Effects

As indicated by the following quotation from Saskatchewan Premier Allan Blakeney, local and provincial governments feel they will be among the groups incurring extra costs as a result of any abandonment of rail lines or elevators.

> Although rationalization of rail lines and elevators may in some cases be necessary for improving the efficiency of the grain handling system...it should not be done at the expense of the farmer....
>
> Preliminary analysis by the Saskatchewan government -- assuming abandonment of all branch lines for which applications have been made -- shows there will be increased trucking costs to the farmer; increased road and highway costs; rural business losses; and costs of unused public investment in such areas as schools, hospitals, power, and telephone systems.[1]

Citizen submissions to the Hall Commission hearings on "B" category lines confirm that farmers and townspeople perceive social and economic loss will result if elevators and branchlines are abandoned. After twenty-five days of hearings, the author concluded branchline abandonment may have a depressing effect on expectations of communities, especially community leaders. Olson[2] limited this expectation factor to elevators when indicating that "farmers are really most concerned about loss of elevator services like moisture testing, weighing, market information, fertilizer and chemicals. Whether grain is trucked or moved by rail from elevators is not that vital provided roads affected are maintained."

---

[1] "Warns About Costs of Rationalization," Western Producer, November 23, 1972, p. 11.

[2] Hon. Bud Olson, "Submission to the Hall Commission," Iddesleigh, Alberta, March 25, 1976, p. 6. (Mimeographed.)

Elevator companies argue as a rule that social effects are either over stated or should not be the imposed duty of the grain handling system. For an example of a good logical presentation of this viewpoint, see the United Grain Growers submission to the Hall Commission.[1]

Except for opinions like those cited above, the author could find no hard evidence to substantiate or measure the social effects on communities of abandonment of elevators or rail lines. At the time of writing, the Hall Commission was charged with obtaining the response of communities to changing circumstances and the socio-economic impact of an evolving network of grain handling and transportation. The hearing process used by the Commission appears to be the only method, albeit crude, for capturing the external effect of system changes on farm and community leader expectations.

## Negative Economic Effects

In a sociological study of the Prairie Community System, Zimmerman and Moneo[2] suggest the prairie community is now in a stabilizing period where isolated farmsteads and various smaller centers with differentiated roles surround some 110 "farm cities" on the Prairies. These smaller centers, farmsteads and farm cities form a stable social community of approximately 15,100 people within a radius of twenty-five miles. The author notes that this distance is somewhat compatible with the inland terminal concept with one terminal in or near the center of a total community system.

---

[1] United Grain Growers, *op. cit.*, pp. 39-53.

[2] Carle C. Zimmerman, and Garry Moneo, *The Prairie Community System* (Ottawa: Agricultural Economic Research Council, 1971), p. 10.

While Zimmerman and Moneo do not discuss grain handling, they lay the problems of small towns at the door of administrators in large cities and community citizens who fail to recognize and solve social issues within each community system as a whole unit. Olsen and Brown also concluded that:

> In general, administrative decisions -- especially regarding such things as the location of hospitals, schools, government agencies, and the construction of highways -- have played an important role in determining which centers might grow.[1]

What, then, have studies found when the grain handling function is specifically evaluated?

In a study of 1951 to 1962 grain shipment and community structure variables for 476 Saskatchewan towns, Hodge[2] concluded that the level or change in value of grain shipments over a decade had no influence on population growth or other community structure variables.

---

[1] H.D. Olsen and J.A. Brown, A Study of the Growth of Selected Service Centers in Saskatchewan, Department of Agriculture Economics RR: 75-03 (University of Saskatchewan, January 1975), pp. 89-90.

[2] Gerald Hodge, "Branch Line Abandonment: Death Knell for Prairie Towns?" Canadian Journal of Agricultural Economics, Vol. XVL, No. 1 (1968), pp. 54-70.

Thus, his study gave "no definite indication that a cessation of the grain shipment function would adversely affect community structure in Saskatchewan centers. Because grain is a proxy for rail shipments, rail abandonment would not cause the death knell of towns."[1] Stabler reported a similar conclusion:

> The study of the few communities losing rail and/or elevator facilities during the past ten years, however, did not indicate that the loss was particularly detrimental.... The reason why the removal did not have a pronounced effect was, apparently, that the service center function is not closely associated with the grain handling operation.[2]

But what about the effect of farmer choices when a point is closed?

Fast[3] demonstrated that the number of permit holders forming the grain assembly hinterland of each point tended to vary directly as the size of the center. He indicated this may suggest farmers do not minimize their truck transport distances but also consider other services at their delivery points. The Canadian Transport Commission[4] confirmed that farmers consider three criteria in addition to distance when selecting an alternate delivery point and elevator company. The study examined the choice by 930 permit holders forced to choose an alternate point because 46 delivery points closed in 1969-70. The criteria used by farmers were:

---

[1] Ibid., p. 69.

[2] J. Stabler, "The Impact of Rail Line Abandonment and Grain Elevator Removal on Rural Communities," in Grain Handling and Transportation Seminar (University of Saskatchewan and Canada Grains Council, 1973), pp. 3-39.

[3] Henry R. Fast, "Changing Communities in Rural Saskatchewan," Canadian Farm Economics, Vol. 7, No. 2 (1972), pp. 12.

[4] Canadian Transport Com mission, Factors Influencing the Choice of a New Delivery Point and Elevator Company by Prairie Farmers Facing Delivery Point Closure (Ottawa: Canadian Transport Commission, Economics Branch, 1972), p. 1.

1. proximity of the new delivery point,
2. service function of the new delivery point (e.g., the availability of shopping centers, hospitals, high schools, post offices, etc.),
3. elevator loyalty,
4. incidental considerations (friendships and road conditions).

However, the Commission was unable to observe any definite order or importance of one criterion compared to the others, but at least one criterion figured significantly in a farmer's choice. No conclusions were drawn on the impact on the town of abandonment of an elevator point or the exercising of the above farmer preferences.

From an analysis of Prairie Regional Studies in Economic Geography of two Saskatchewan areas, Fast[1] identified that where effect exists, it varies according to community size. Since the ratio of farm hinterland population to community population decreased as the centers grew, he concludes that "the life of the very small center is very heavily dependent on grain deliveries whereas the life of the larger center is not."[2] He goes on, however, to point out that some communities continue to exist that never had a railway or elevator; he shows economic and population declines of centers such that he concluded

---

[1] Fast, op. cit. (1972) p. 8-19.

[2] Ibid., p. 15.

"death has come to communities despite the continued presence of the rail line and grain elevator."[1]

In a specific examination of the effects of closing out 540 points on lines up for abandonment in 1975, Underwood, McLellan and Associates[2] found it important to separate points into three types: those where elevators were the only economic activity (group one), those where the elevator was a large part of community economic activity (group two), and those where there was sufficient economic activity to sustain the community following the removal of the elevator (group three). Their survey of farmer shopping changes as a result of closures of elevators in communities in groups one and two showed only 15 percent of farmers changed shopping patterns as a result of the elevator loss.[3] They also conclude "that the service center function is not closely associated with the grain handling operation."[4]

Underwood, McLellan and Associates went on to conclude "the major impact of removal is confined to the number of jobs directly connected with grain handling and railroad employment, and that the indirect effect is minimal"[5] In group three communities, the employment loss would not be serious since the community's service function would continue independently. In the 237 centers in groups one and two, Underwood concludes the removal of the elevator would not alter what appears to be inevitable, but would affect at most 1,000 jobs and 5,500 persons. Since most railway and elevator personnel would be employed elsewhere and the shopping survey showed low effects on shopping patterns, Underwood estimates only 200 employees and their immediate families (600 to 800 persons) would actually be affected from the closure of 540 elevator points.[1]

---

[1] Ibid., p.6.

[2] Underwood, McLellan and Associates Ltd., Economic Effect of Rationalization of the Grain Handling and Transportation System on Prairie Communities (Saskatoon, 1972).

[3] Ibid., p. 51. The changes are mostly in other items (like seed) sold by the elevator. Farmers that died or moved outnumbered those that changed their shopping.

[4] Ibid., p. 51.

[5] Ibid., p. 56.

The Canada Grains Council[2] and Shurson[3] showed diversion of grain traffic causes additonal expenditures on highway construction and maintenance. These costs come about as a result of increased frequency of use by trucks and of the increased load factor requiring better surfaced roads. Frequency and load factors arise as a result of either a) centralization of the existing elevator system or b) rail line abandonment. Alberta Transportation estimated the marginal road impact of rail abandonment through a manual road-by-road and line-by-line assessment. Key factors considered include:[4]

1. Existing road inventory and capital improvements already planned into the future,

---

[1] Ibid., pp. 56-57.

[2] Canada Grains Council (1974a), op. cit., p. 40.

[3] G.W. Shurson, "A Study of the Impact of a Rationalized Grain Handling Industry on Roads and Highways of Saskatchewan," quoted in Kulshreshtha, 1974, op. cit., p. 23.

[4] Alberta Transportation, op. cit., pp. 2-5.

2. Estimated normal traffic now and in future,
3. Distance to alternate rail services,
4. Size of truck,
5. Volumes of grain on the line.

That study showed 2,045 miles of rural roads are affected by abandonment of "B" lines in Alberta for a total extra cost over 25 years of $22,925,600 (in net present value) or $15,348 per mile of "B" category rail line.[1]

## Positive Economic Effects

Fast[2] and Zasada[3] both showed that while elevator numbers declined in Saskatchewan during times of rationalization or rail line abandonment, the absolute storage capacity grew in neighboring delivery points. Zasada showed that lost storage space was replaced in annexes at many neighboring points if there was risk of further rail abandonment. If the risk of further abandonment of adjacent lines was not significant, the build-up of capacity tends to be concentrated in larger centers in the form of increased numbers of elevators (rather than annexes). Long run trends for the whole Prairies confirm this build-up in storage (from 367 million bushels capacity in 1962 to 377 million 1972) despite reductions in the number of elevators (from 5,226 in 1962 to 4,567 in 1972). Thus, while some communities lose elevator space, others gain.

---

[1] *Ibid.*, p. 6, and author's estimate

[2] Fast, *op. cit.*, (1972) p. 12.

[3] D. Zasada, "The Probable Effects of the Application for Railway Branch Line Abandonment on the Grain Elevator Industry," *Canadian Farm Economics*, Vol. 3, No. 1 (1968), pp. 20-23.

To the author's knowledge, no studies have been completed[1] that identify all other possible positive effects induced by abandonment. Some of these include:

1. Increased employment and taxes from additional farm or commercial trucking.

2. Increased employment and value added from cleaning at larger high throughput elevators or inland terminals.

3. Increased jobs from additional road maintenance.

4. Additional value of land use from using abandoned rights-of-way for farming, or recreation, or alternative transportation corridors.

Additional studies are needed to identify these positive effects.

## Summary

Literature identified above and twenty-five days of local hearings of the Hall Commission in Alberta cause the author to conclude that:

1. Research to date indicates the reductions in the economic and social life of small Prairie centers is largely independent of any reductions in the number of elevators.

2. The elevator appears to be very important to very small centers only. This importance arises largely because changes

---

[1] At the time of preparing this study, Crown was identifying induced economic impacts of rationalization for an area of Saskatchewan. R.W. Crown, "Project Outline for Study on the Rural Development Implications of Branchline and Elevator Rationalization in West Central Saskatchewan Area," Ottawa, Agriculture Canada, Economics Branch, 1975. (Mimeo.).

in the grain handling and transportation system have been slower in coming than other social and economic changes in Prairie communities. The loss in annual taxes is a measure of the cost to communities and government.

3. Indirect effects on other community services as a result of closing elevators are minimal and are primarily in very small centers and only in proportion to the salaries and population directly involved in grain handling and transportation.

4. Redirecting grain truck traffic as a result of elevator or branchline closures causes an increase in capital and maintenance costs of roads.